Compressed Air Magazine

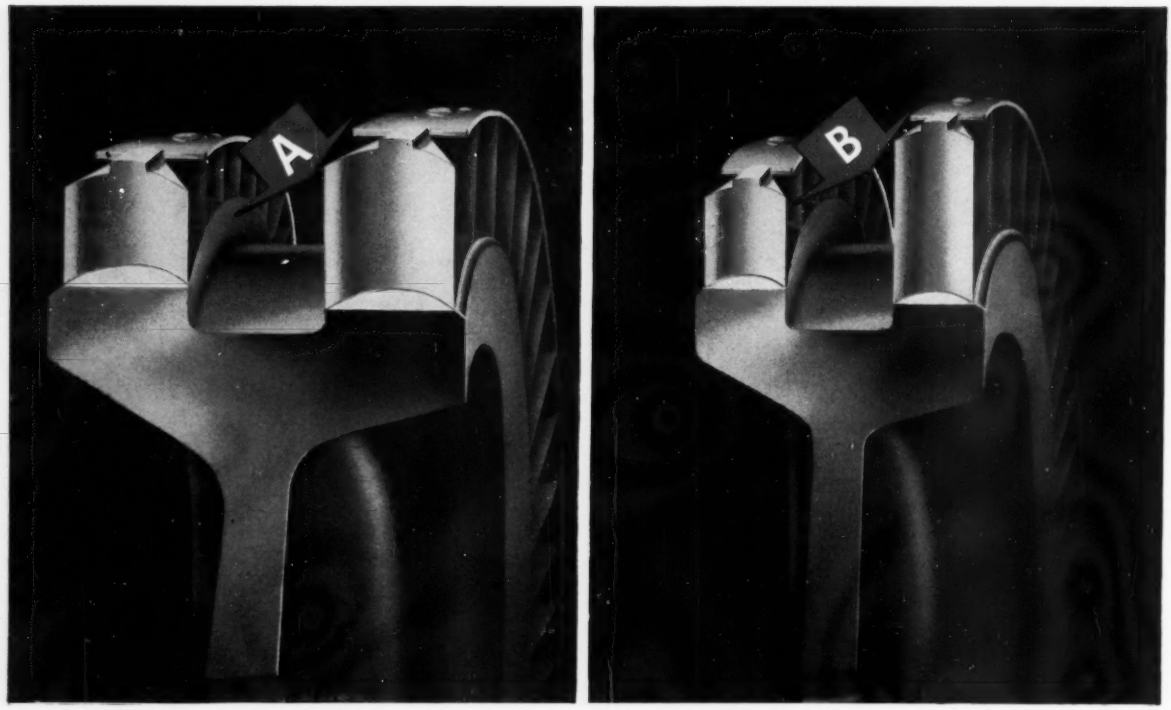
MARCH 1958

BUSY LOCKS AT SAULT STE. MARIE

Famed canal has world's largest locks, passes greatest tonnage

(SEE INDEX PAGE AND PAGE 10)

VOLUME 63 • NUMBER 3 NEW YORK • LONDON



(Left, A) wide bucket "L" type wheel. (Right, B) regular type wheel for Coppus Steam Turbines

Now...for low steam consumption – **COPPUS TURBINES** *can be furnished with wide bucket "L" type wheel*

Good news for steam turbine users where low steam consumption is important!

The Coppus Type "L" Wheel is the answer to this problem. Larger turbine buckets are employed to make the most economical use of steam.

In every respect the Coppus Turbine offers the top-quality features and advantages that have made the Coppus line outstanding for efficiency and economy. For example:

- Turbines rated close to your exact hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther.* Send for Bulletin 135 on Coppus Turbine.

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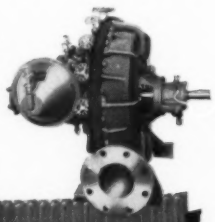
Sales offices in
THOMAS' REGISTER

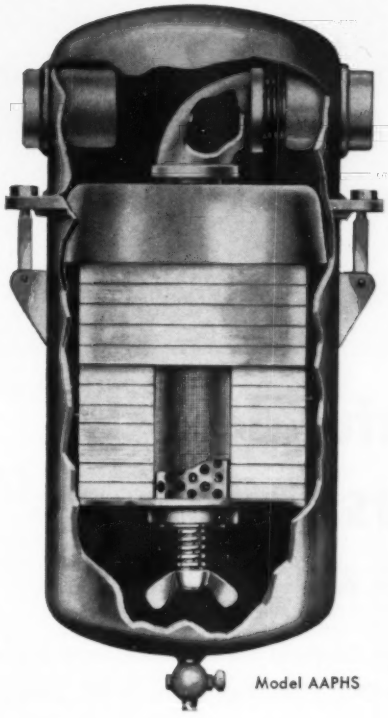


COPPUS "BLUE RIBBON" TURBINES

Circle 1A on reply card

does the WEATHER get in your AIR LINES?

you need STAYNEW ABSORPTION FILTERS

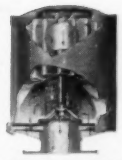


Model AAPHS

At this time of year—when the humidity is high—your compressed air lines carry lots of water . . . water that can rust and clog your equipment, ruin your work, or shut down your boilers.

That's why you need Staynew Absorption Filters in your lines. They remove every last trace of oil and moisture. In thousands of installations throughout the country Staynew Absorption Filters are protecting equipment and preventing process interruption . . . in most cases they are positively essential.

Write for Bulletin 200 which contains complete engineering data and illustrated material on Staynew Pipe Line Filters, including Model AAPHS Absorption Filter. Dollinger Corporation, Dept. 7, Centre Park, Rochester 3, N.Y.

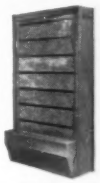


INTAKE FILTERS

LIQUID FILTERS

PIPE LINE FILTERS

ELECTRO-STAYNEW PRECIPITATOR



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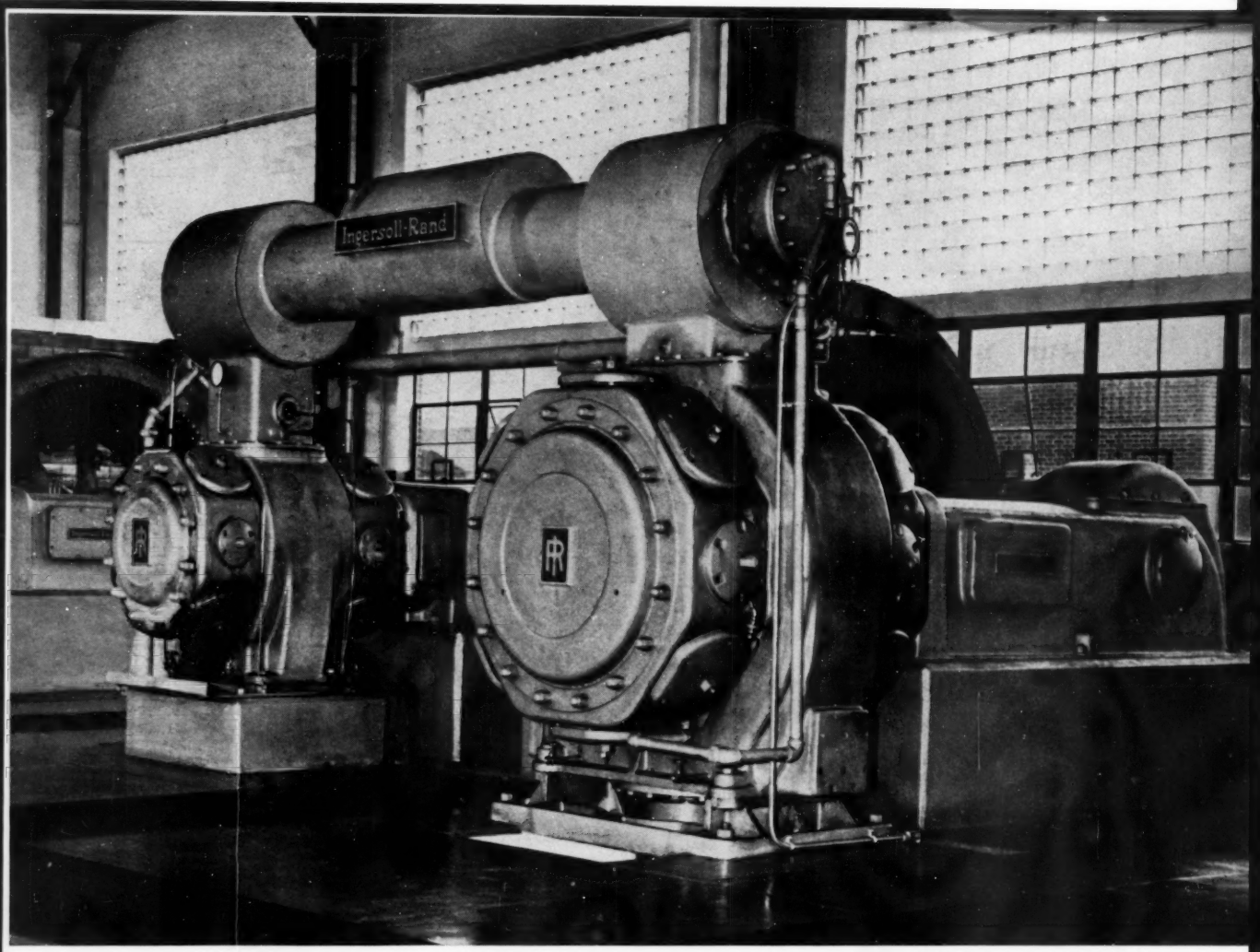

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. . . USE TEXACO REGAL OIL R & O

A sure way to prevent rust and harmful deposits in compressor systems is to lubricate and protect them with Texaco Regal Oil R & O. It is both rust and oxidation inhibited, protects cylinders, valves, etc. against the formation of rust and gum . . . helps keep compressor operation clean and efficient, whatever the working conditions.

There is a complete line of Texaco Regal Oils R & O. A Texaco representative will recommend the right one for your type, size and make compressor and operating condition. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write: The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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Compressed Air Magazine

Founded 1896

VOLUME 63 NUMBER 3

March 1958

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New Birks Building, Montreal, Quebec

ON THE COVER

MORE freight tonnage passes through the famed locks of the St. Marys Falls Canal at Sault Ste. Marie, Mich., in an average 8-month season than the combined tonnage handled by the Panama and Suez canals in 1 year. All traffic is passed free of tolls. Its David and Sabin locks are the longest in the world, and each can handle two large lakers at one time, locking them through in an average of 30 minutes. A hydroelectric power plant completed in 1954 supplies the area and the locks with 14,500 kw. The canal makes possible navigation of St. Marys Rapids, a ¼-mile-wide, ¾-mile-long torrent having water velocities of about 24 mph. The total drop through the rapids is about 21 feet.

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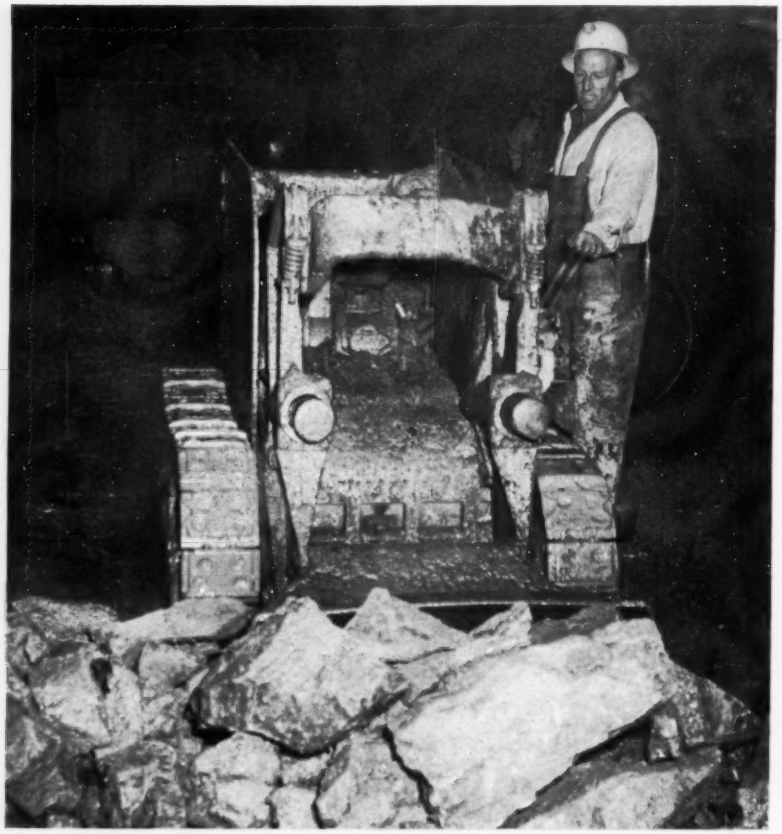

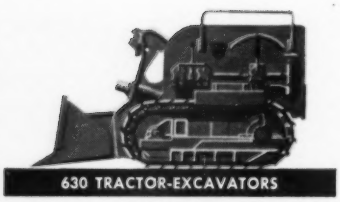
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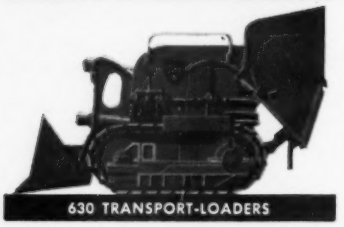
630 TRACTOR-DOZERS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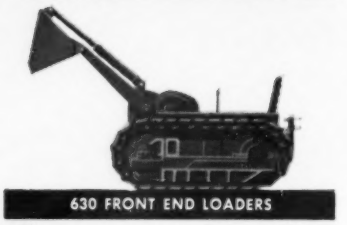
635 LOW-HEADROOM LOADER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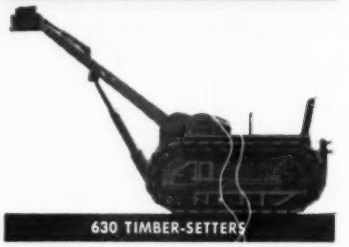
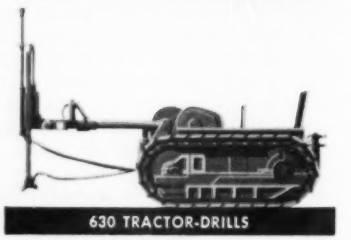

630 TIMBER-SETTERS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Eimco 630's with their many patented features provide unusual ruggedness and dependability that is exclusive with Eimco equipment.

Low operating and maintenance costs with high production and unequaled maneuverability make the 630 the preferred machine for underground trackless operation in rock headings and tunnels.

Hundreds of 630's in operation as excavators, bulldozers, transports and other variations have shown a lower cost per ton moved, transported or loaded than any previous equipment.

For low cost material handling of this type, write Eimco for more detailed information. There is an Eimco for every loading operation underground.

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B306

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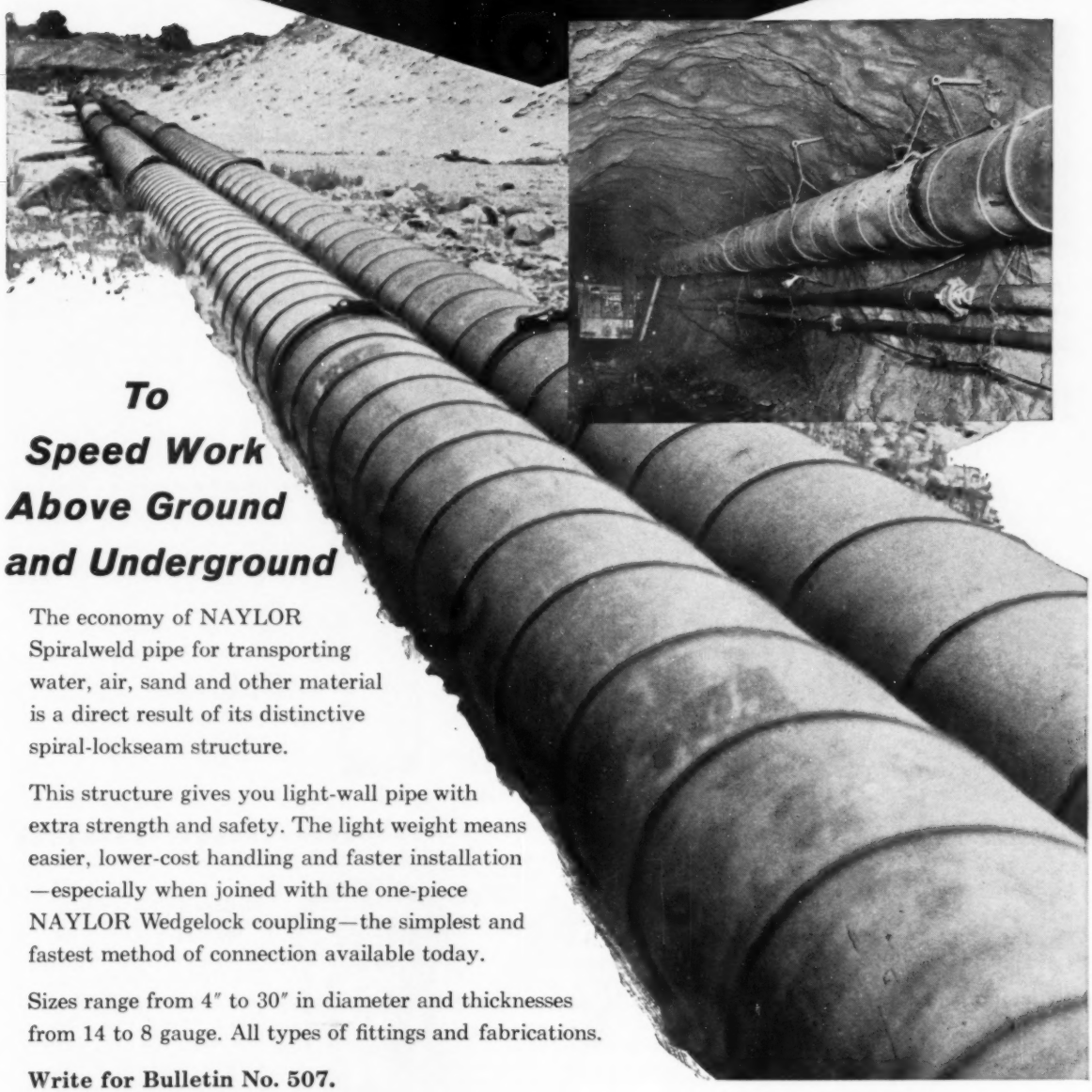

To Speed Work Above Ground and Underground

The economy of NAYLOR Spiralweld pipe for transporting water, air, sand and other material is a direct result of its distinctive spiral-lockseam structure.

This structure gives you light-wall pipe with extra strength and safety. The light weight means easier, lower-cost handling and faster installation —especially when joined with the one-piece NAYLOR Wedgelock coupling—the simplest and fastest method of connection available today.

Sizes range from 4″ to 30″ in diameter and thicknesses from 14 to 8 gauge. All types of fittings and fabrications.

Write for Bulletin No. 507.

NAYLOR

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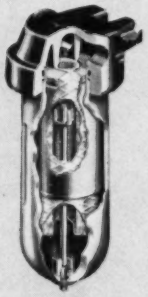
NEW Nickel-Plated Brass *Fulflo Filter* for Compressed Air

This new compressed air Fulflo Filter (B-R) is made of gleaming nickel-plated brass . . . sanitary and non-rusting. 7-inch Honeycomb Filter Tubes minimize gumming — remove moisture, oil, microscopic dust, rust, dirt, and scale. Flow rate is as high as 76 cfm of free air at operating pressure of 100 psi. ⅜ or ¾ inch N.P.T.

For a new catalog on Fulflo Filters for compressed air, CO_2 and other gases, write to Department CA.

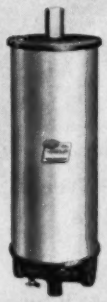
Single Tube Fulflo Filters

B-A model has 3, 5 or 7-inch Honeycomb Filter Tubes for 10, 30 and 60 cfm at operating pressures up to 125 psi. AF model has flow rate of 60 cfm at operating pressures up to 250 psi. ¾ inch NPT.



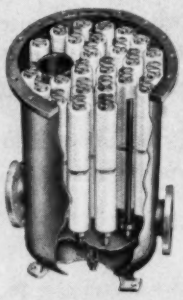
Hi-Pressure Fulflo Filter

Tested at hydrostatic pressure of 8,000 psi, this filter withstands operating pressure up to 4,000 psi. 7-inch Honeycomb Filter Tubes for 1.5 cfm at 4,000 psi (equivalent of 410 cfm of free air).



Multi-Tube Fulflo Filter

For high flow rates or central installations. Three, six, twelve, or eighteen Honeycomb Filter Tubes in parallel. Steel-and-iron, stainless steel, or nickel-plated brass containers. For 1½ and 2-inch pipes. Operating pressure up to 100 psi.



Hi-Capacity Fulflo Filters

This rugged filter is made in 10 sizes — from 22 to 270 10-inch Honeycomb Filter Tubes in parallel. Sturdy welded steel construction — 304 or 316 stainless steel to order. For 3, 4, and 6-inch pipes. 100 psi operating pressure.

COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST

Fulflo FILTERS — *with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.*

CFC FILTERS — *Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.*

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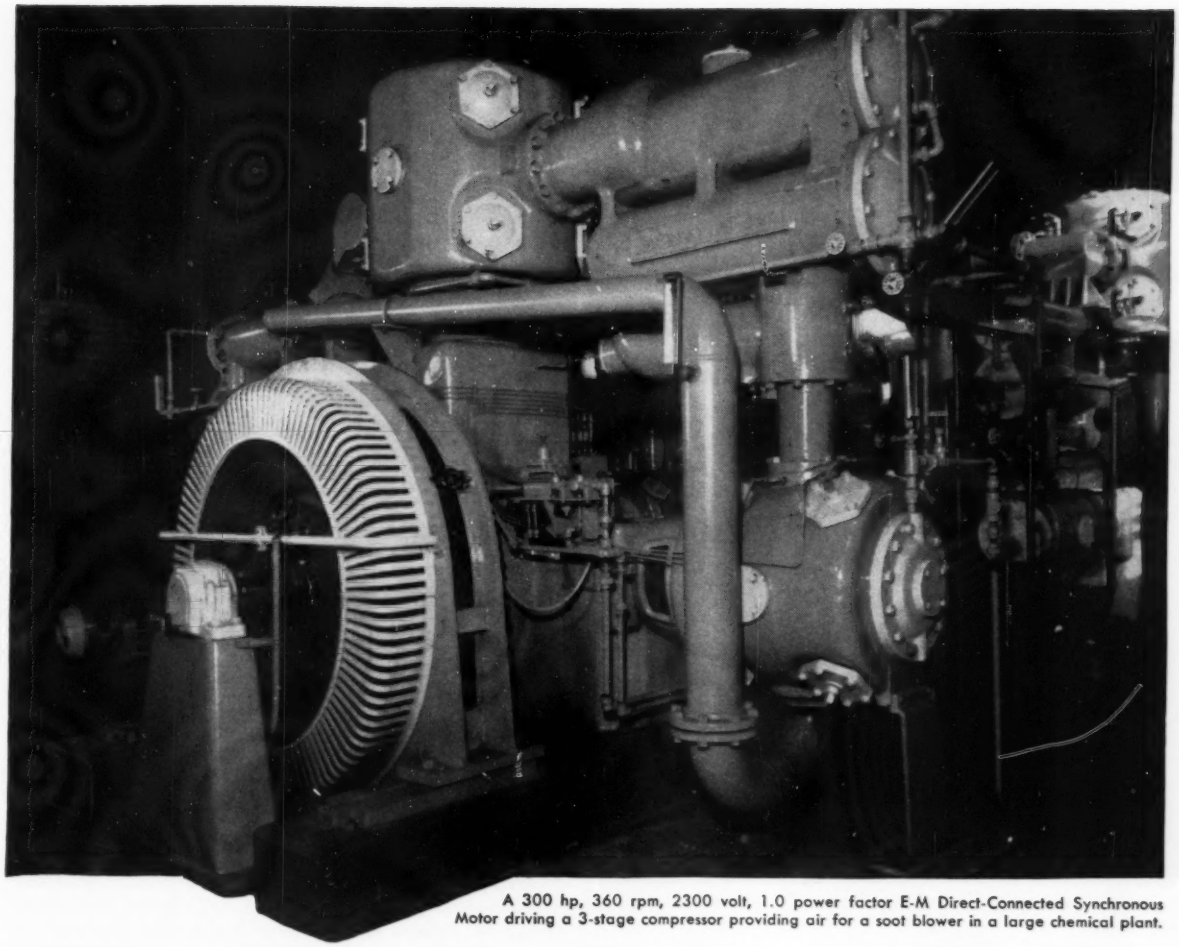

A 300 hp, 360 rpm, 2300 volt, 1.0 power factor E-M Direct-Connected Synchronous Motor driving a 3-stage compressor providing air for a soot blower in a large chemical plant.

What every new compressor should have

● Nicest thing you can do for a new large compressor is to couple an engine-type synchronous motor to it. There's no better way to assure a most economical, reliable and trouble-free drive. Look at the advantages:

1. HIGH EFFICIENCY conversion of electric power to mechanical power by synchronous motors . . . resulting in minimum electric power cost operation of the compressor.

2. POWER FACTOR CORRECTION by unity or 0.8 leading power factor synchronous motors . . . supplying leading reactive kva to improve plant power factor and further reduce power costs, save money on your power bills.

3. DIRECT-CONNECTED synchronous motors save valuable floor space and require minimum maintenance.

4. SIMPLE STARTING at full voltage is suitable for most direct-connected synchronous motor compressor applications. Or you can use E-M-invented part-winding starting where starting limitations are severe. E-M starting arrangements are low in first cost and maintenance cost.

And there's nothing nicer for your compressor than an *E-M* Direct-Connected Synchronous Motor. E-M, pioneers in the development of synchronous motors and control, have over 40 years' experience in the design of synchronous motors incorporating desirable characteristics and features such as those above.

Let the E-M specialist engineer team design a smooth-running, modern drive unit to meet the requirements of your new compressor application. For complete information on E-M Synchronous Motors and their application in your plant, consult your nearest E-M sales engineer. And write for the issue of the E-M Synchronizer titled "The ABC of Synchronous Motors".

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

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E-M

SPECIALISTS IN
BIG MOTOR ENGINEERING

Circle 7A on reply card

New Dam on the Skagit

In Mount Baker National Forest, in Washington, wagon drills and jackhammers have been boring into hard granite along the Skagit River. Equipped in most cases with Bethlehem Hollow Drill Steel, these drills are putting down blast holes so that about 400,000 cu yd of rock can be moved to make way for the high Gorge Dam, a project of Seattle City Light.

The new dam, of concrete construction, is scheduled for completion in 1960. It will be about 670 feet long and 285 feet high, and will replace the existing Gorge Division Dam. By providing an 88-ft higher head of water, the capacity of the Gorge Powerhouse will be increased from 108,000 kw to 165,000 kw.

Whatever the type of rock removal, you're sure to get dependable drilling, and minimum breakage, with Bethlehem Hollow. This is because it is rolled from a special fatigue-resistant steel, and has a uniformly round hole which is centrally located in the bar. Bethlehem Hollow has a wide quenching range. It can be heat-treated easily for the proper balance of toughness and wear-resistance, resulting in durable threads and shanks.

Bethlehem Hollow, in Carbon and Ultra-Alloy grades, comes in rounds, hexagons, and quarter-octagons in lengths from 18 to 27 ft. Longer lengths can also be furnished to meet special requirements.

You'll like Bethlehem Hollow.

Using 1-in. hexagon Bethlehem Hollow for 12-ft blast holes at site of high Gorge Dam, on Skagit River, in Washington. Contractors: Merritt-Chapman & Scott Corporation.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM HOLLOW DRILL STEEL

CARBON AND ULTRA-ALLOY

BETHLEHEM STEEL

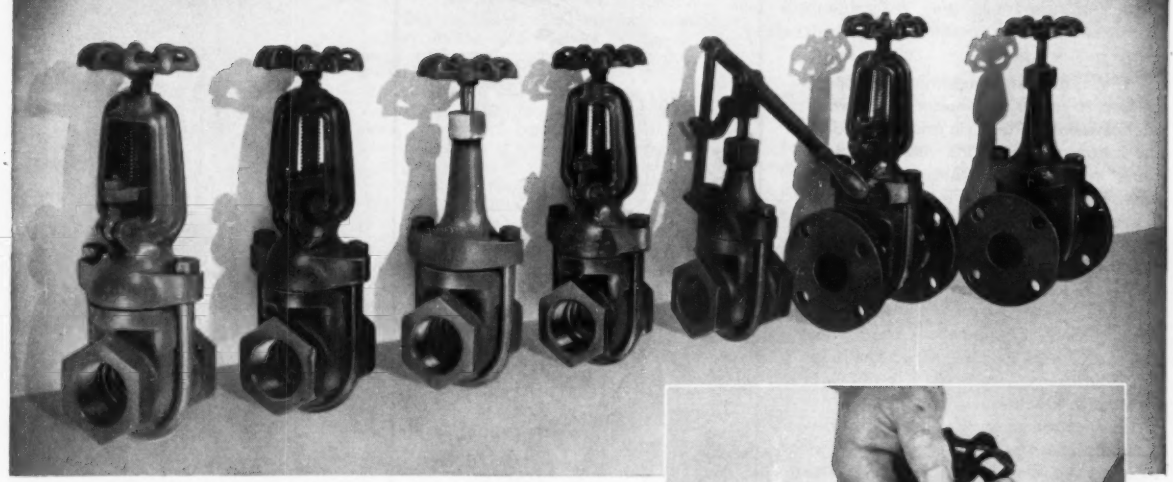
Circle 8A on reply card

Eleven lines of WALWORTH Saddle Type Wedge Gate Valves

Bronze-Mounted — All-Iron — Ni-Resist

Outside Screw and Yoke — Non-Rising Stem — Quick Opening

Flanged Ends — Screwed Ends



Walworth saddle-type wedge gate valves are manufactured in eleven different combinations of designs and materials, seven of which are illustrated above.

Saddle type wedge gate valves are easy to take apart and are particularly suitable for lines requiring frequent cleaning. Walworth Saddle-Type Wedge Gate Valves are available in a variety of designs including OS & Y; Inside Screw Rising Stem, and Sliding Stem Quick Opening types—in Bronze-Mounted, All-Iron, and Ni-Resist. All types are designed to permit repacking under pressure in either the open or closed position.

FOR COMPLETE INFORMATION, See your local Walworth Distributor or write on business stationery for illustrated circular.

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Circle 9A on reply card

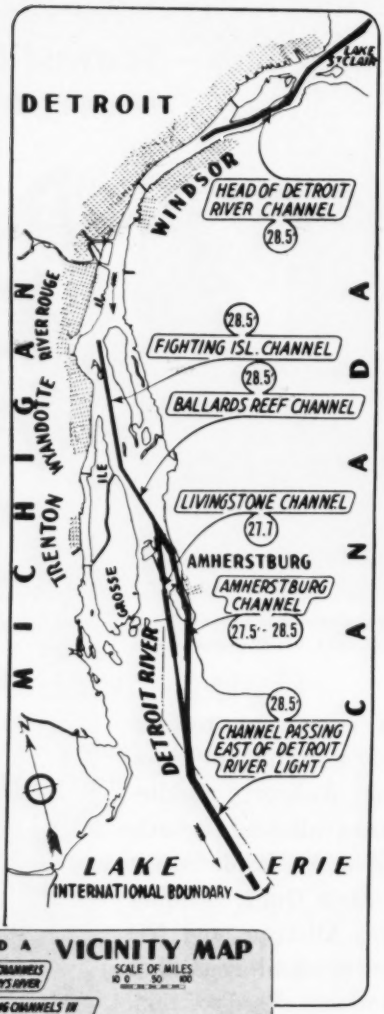
CHANNEL BLASTING AT AMHERSTBURG

$23 million worth of contracts calling for extensive subaqueous rock drilling are underway in the Detroit River Channel

R. J. NEMMERS

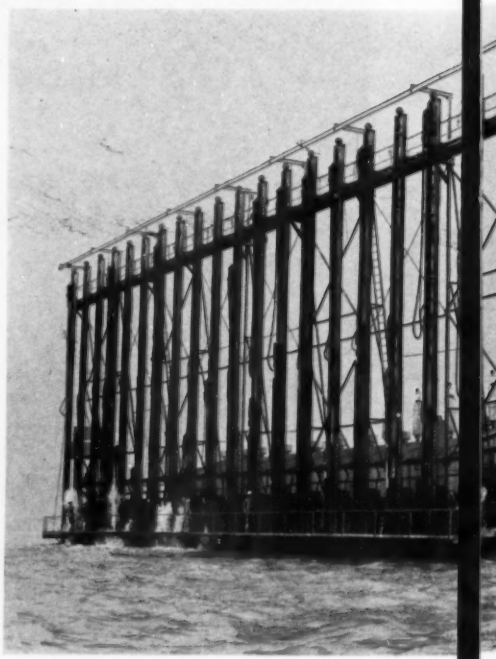
IT WILL cost an estimated $136 million to ready the connecting channels between Lakes Erie and Superior for the influx of deep-draft vessels that will come with the completion of the St. Lawrence Seaway. To take an estimated 5 years, the project got underway last May when work began on $23 million worth of contracts by Marine Operators, a new Lakes combine consisting of Al Johnson Construction Company, Peter Kiewit Sons Company, Cunningham-Kiewit Company and Morrison-Knudsen Company; and by Great Lakes Dredge & Dock Co.

The connecting channels improvement program is of as great importance to the vast inland waterway envisioned by its planners as is the St. Lawrence Seaway. Either project without the other would result in a considerable diminution of the economic benefits of both. The Seaway is being constructed to a governing depth of 27 feet to handle lakers and ocean-going vessels drawing up to 25.5 feet of water. To enable these ships to ply the Great Lakes, the channels connecting the five bodies of water must have the same controlling depth.



LOCATION MAPS

The smaller map above shows the essential points of the Great Lakes Channel Improvements Program. The other is a map of the Detroit River showing the work that must be done there. The figures in circles are the depths to which the channel will be deepened in the respective sections.



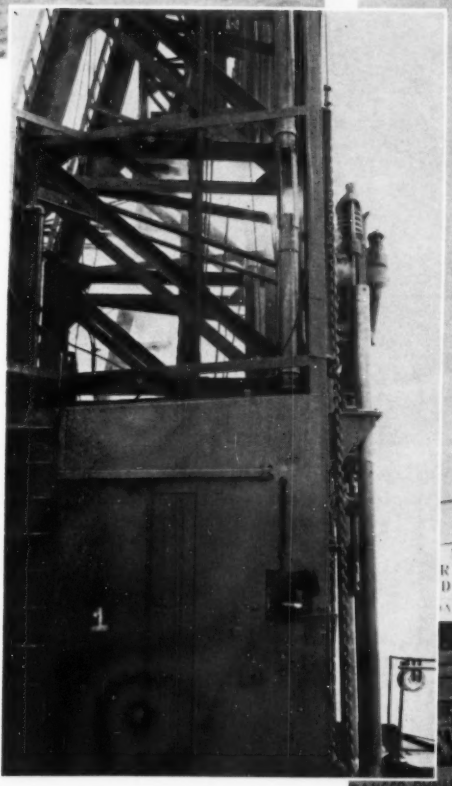
"HORNET IV" AND FRIEND

Marine Operators' barge "Hornet IV," newly commissioned to handle the necessary drilling and blasting on the firm's $23 million contract for deepening the Amherstburg Channel of the Detroit River, is shown above. The other picture shows the "Steve W.," service boat for the barge, that hauls crews, explosives and maintenance parts out to the huge drill boat. She also was built new for the job and is of all metal construction.

The St. Marys River, including the shoal waters at its head, has been developed into the channel between Superior and Huron. The river leaves Lake Superior at Point Iroquois, flowing generally southeast for a distance of some 70 miles to Lake Huron. In this distance it drops about 22 feet, most of the decline coming at St. Marys Falls at Sault Ste. Marie. Here, the famed locks annually carry more traffic than do the Suez and Panama canals, combined.

Lakes Huron and Michigan are joined by the deep, wide Straits of Mackinac that will require relatively little deepening; the two lakes, from a navigational standpoint, are one.

Between Lakes Huron and Erie lie



STEAM DRILLS

Four Ingersoll-Rand SP8 drills form the battery on the Great Lakes Dredge & Dock drill boat. Steam-powered, the units drill holes averaging about 8 feet in depth, using Carset bits of 4¼-inch size. Steel of 40- to 44-foot lengths is used, the towers being 60 feet high. The illustration at the lower left shows a close-up of one of the drill towers. The operator's platform is enclosed for weather protection.

the St. Clair River, Lake St. Clair and the Detroit River, roughly an 87-mile waterway that drops some 8 feet between its upper and lower ends. Lake St. Clair makes up about 18 miles of the connecting link and joins the two rivers. The St. Clair and Detroit rivers are 39 and 30 miles long, respectively. Their water-surface profiles are relatively uniform and water flows through freely, no locks being required for navigation.

The outlet for Lake Erie is the Niagara River which drops some 326 feet in but a few miles. Vessels are lifted around Niagara Falls and its rapids and raging whirlpools by the Welland Canal. Deepening of this waterway was described in COMPRESSED AIR MAGAZINE, November 1957.

Not including the work being done by Canada in the Welland Canal, the Channel Improvements Program calls for the removal of an estimated 3,702,000 cubic yards of ledge rock, 24,472,000 cubic yards of material that can be dipper- or

bucket-dredged and 16,093,000 yards of material that will be hydraulically removed. Most of the dipper and hydraulic dredge work will be done in the St. Marys River where at eight stretches comprising almost 24 miles of the channel, some 21 million cubic yards of material will be removed, 13,195,000 by dippers and 7,872,000 by hydraulic means. In addition, an estimated 1,331,000 cubic yards of ledge rock will have to be taken out. Present governing depths in the St. Marys Channel vary from as little as 13 feet to more than 30 feet.

Although the entire length of the Straits of Mackinac is now at least 27 feet deep, two projects, comprising about ½ mile will be undertaken, and these call for the removal of 86,000 cubic yards of rock on one project, and the dipper-dredging of 32,000 cubic yards of sand, clay and boulders on the other.

Along the St. Clair River on four sites, totaling a little less than 36 miles, an estimated total of 9,126,000 cubic yards will have to come out of the channel. About two-thirds of this will be taken with dipper dredges and the remainder by hydraulic equipment. The present governing depth in the river is 25 to 25.5 feet, and its width varies from 700 to 1400 feet.

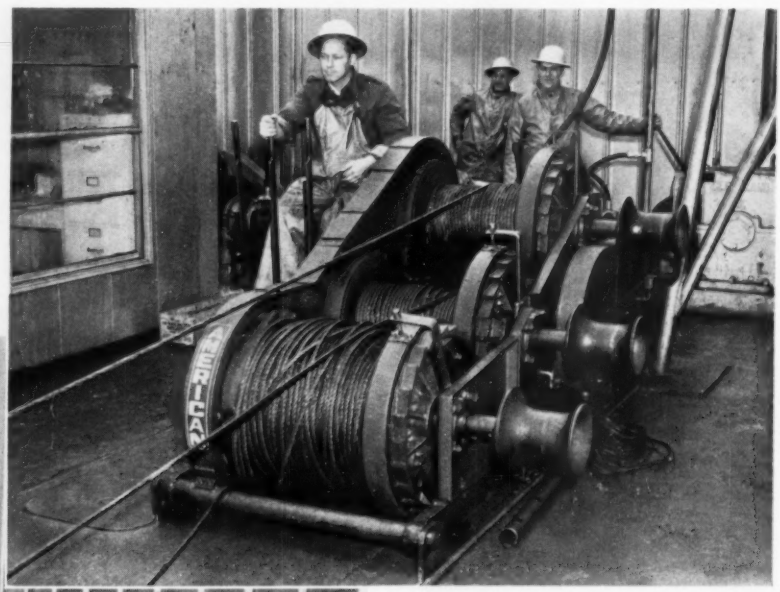
In Lake St. Clair, 81,400 feet of channel, 800 feet wide, must be deepened. U. S. Army Corps of Engineers' estimates call for the removal of 1,050,000 cubic yards of dipper-dredge material and 800,000 yards of hydraulic-dredge spoil.

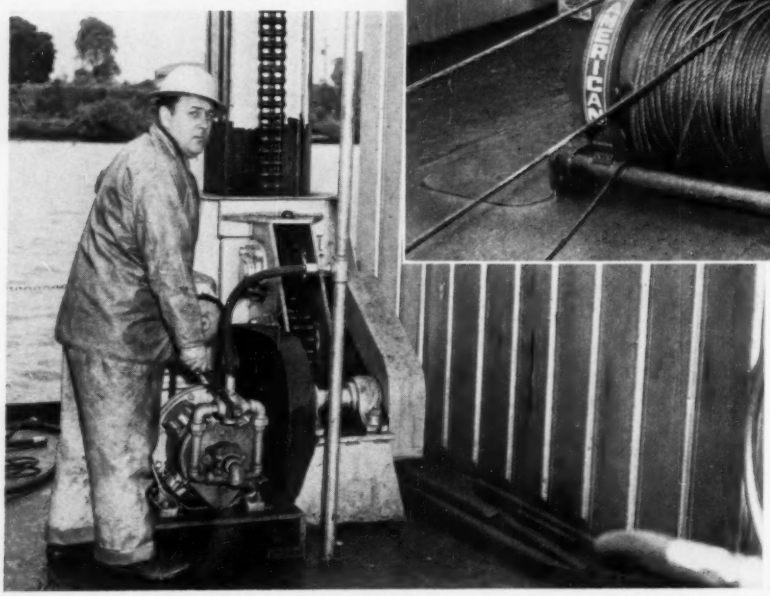
In the Detroit River there are four projects encompassing about 28 miles of the stream's 30-mile length. At the head of the river, some 900,000 cubic yards of clay, sand and boulders will be dipped out. Fighting Island Channel will require the removal of some 800,000 yards of clay and boulders, and the channel east of the Detroit River Light will require the hydraulic dredging of 5,100,000 cubic yards of sand and clay. The present governing depth of these sections is 25 to 26 feet. In the Amherstburg Channel, which is the subject of this article, some 2,285,000 yards of ledge rock are being taken out, in addition to an estimated 1,690,000 yards of dipper-dredge material. Here, the present depth at mean low water is but 21 feet.

Of all the phases of the deepening program, the Amherstburg Channel is perhaps the most important at the present time. The St. Lawrence Seaway is scheduled to be completed with the opening of the 1959 shipping season. Available depths in the Amherstburg Channel, as well as a portion of the St. Marys Channel, thus will be the limiting factors of Great Lakes transportation. Then too, lake stages in recent years have been at exceptionally high levels, but are now receding, it is said; and there is little chance that they will return to the recent peaks. With the completion of work in the Amherstburg Channel and St. Marys River, the governing depth throughout the Lakes will be increased to 25 feet, where it will remain until all the work is essentially completed. Thus it is planned that these first and most essential projects (both contracts have now been let, along with some others) will be completed at least by 1960, so as to be ready for the opening of the 1961 season. Final stages of the project, carrying all channels to 27 feet deep, are planned to be finished in time for the start of the 1963 navigation period.

There are two channels in the Detroit River as it passes the City of Amherstburg, Ont. The one that bears the name of the town is the up-bound one and the other, called the Livingstone Channel, is the down-bound passage.

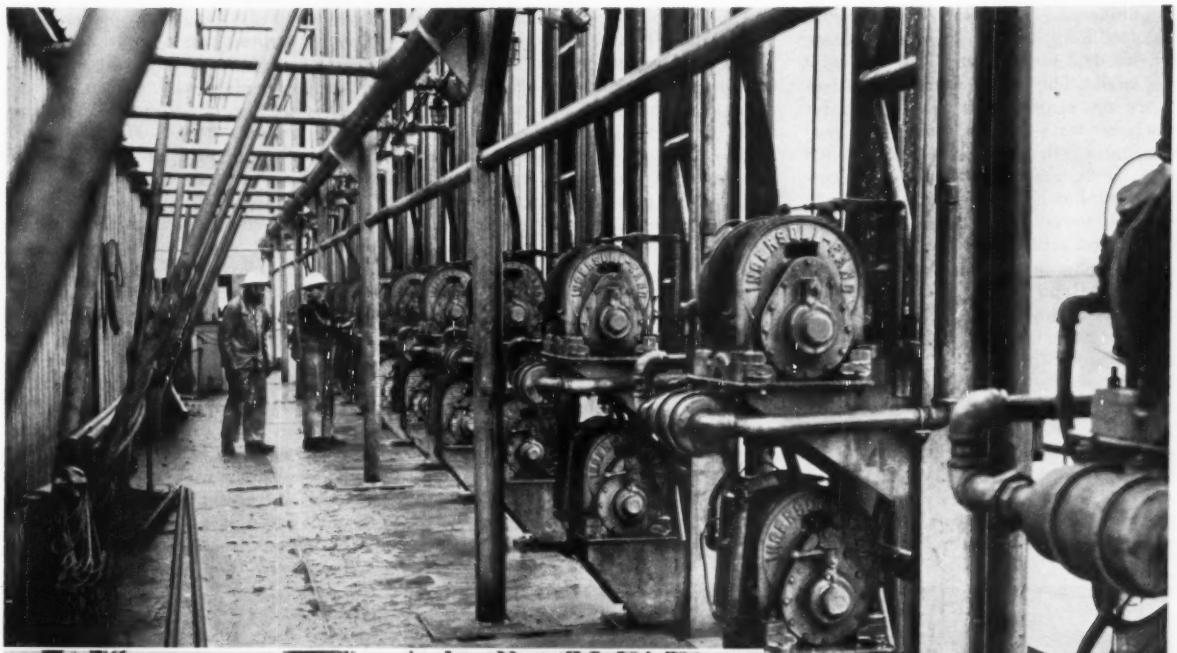
The basic project that provided channels in the St. Marys, St. Clair and Detroit rivers for vessels drawing up to 20 feet of water was adopted in 1892. The average iron-ore carrier of the day had a capacity of about 1750 tons. The average load today is about 11,000 tons, and many new vessels are in use or are being readied that carry a great deal more. Traffic through the St. Marys Channel

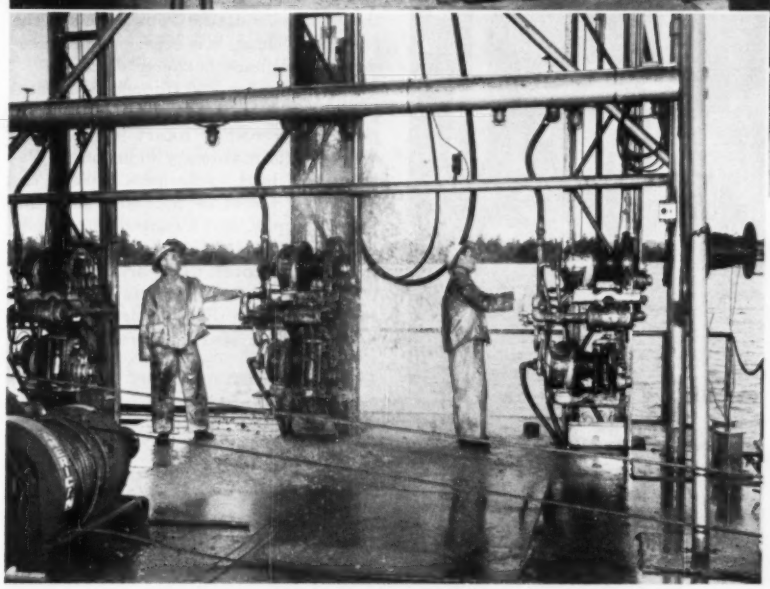




ALIGNING

Shown at the left is the raise-lower mechanism on one of the four spuds. Powered by an Ingersoll-Rand air motor, the spud is driven through a mechanical gear linkage acting on a link chain. The picture above shows one of the two American 3-drum winches that position and align the barge. Also driven by I-R air motors, the winches take-up and pay-out on lines anchored to the shore and in the channel. At the operator's left a portion of the "field office" can be seen.





TOWER CONTROLS

Above is a view looking along the hoist set-up for the 20-tower rig. There are 40 of the Ingersoll-Rand HUD units in all and, as shown in the other picture (left), they are equipped with a single set of remote controls at the operator's waist level for easier operation. The coil of wire seen at the right in this picture is for the blasting circuit. The large pipe at the top is the air manifold. The feeders supplying it with air from the compressors can be seen in the other general view.

of iron-ore boats alone has increased about six times in the last 60 years, growing to a total of more than 60 million tons a year. Two-thirds of this, travels on through Lake Huron and passes down the Detroit River into Lake Erie. The total of all goods that have moved on the inland sea has reached a yearly high as great as 215 million tons. Quite frequently, it has been a fact that not enough shipping capacity was available on the Lakes, to handle all the cargoes on hand. This illustrates the importance of the deepening project. Army Engineers estimate that for each inch of usable draft that is added, the present Lakes fleet can carry an additional 1,500,000 gross tons per year.

As vessels leave Lake Erie and enter into the mouth of the Detroit River, the channel divides almost immediately and these ships enter the Amherstburg Channel. Pilots know sections of the water pass as Bar Point Range, Hackett Range, Amherstburg Reach and Limekiln Crossing. Just upstream from Limekiln Crossing is the Ballards Reef Channel, at about the midpoint of which the upstream and downstream channels meet. The work to be done under current contracts calls for the dredging of Ballards Reef Channel from its junction with Limekiln Crossing, a distance of about 6100 feet, for the entire 600-foot width of the channel, to a minimum-swept-depth of 27.5 feet; deepening the western 300 feet of Limekiln Crossing and Amherstburg Reach for their entire lengths (about 11,900 feet) to a minimum depth, also of 27.5 feet; dredging the western 300 feet of Hackett Range and a varying width of Bar Point Range to a minimum depth of 28.5 feet, along the entire length of some 23,700 feet; and the building of about 15,000 linear feet of compensating rock-fill dikes.

As we have said, more than 2¾ million cubic yards of the material to be removed is ledge rock that must be drilled and blasted. To do its share of this, about 2,000,000 yards at a contract price of $16.6 million, Marine Operators has commissioned a new drill boat, *Hornet IV*, that relies almost completely

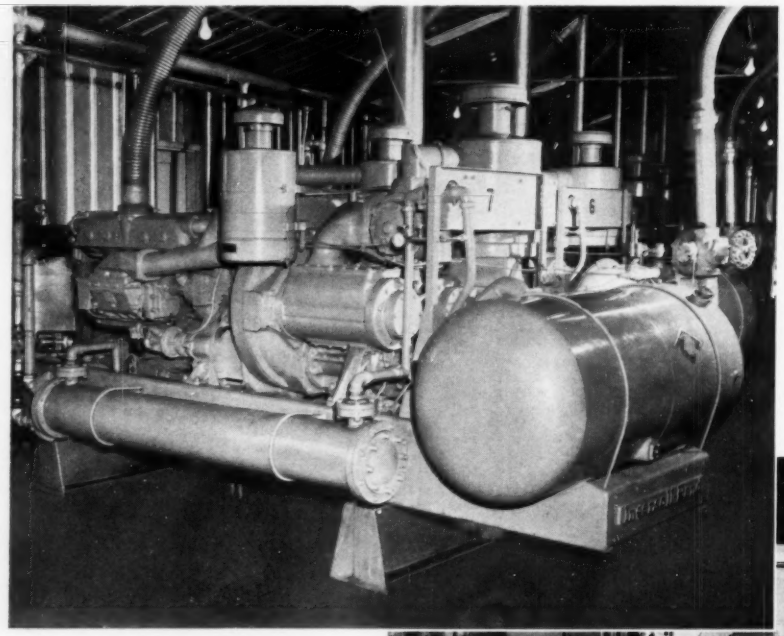
on compressed air power. The vessel is 160 feet long, 30 feet wide and boasts twenty drill towers, each of which is 50 feet high. The towers are spaced 8 feet apart on centers and are stationary. Each carries a slab-back-mounted, percussion-type drill equipped with 4½-inch bits. Drilling is being done through casings, and one is mounted on a slab-back on each tower. To raise and lower the casing and drill, each tower is equipped with two compressed-air-powered hoists, Ingersoll-Rand Model HUD units. Each pair has a single set of centralized remote-controls for easier operation. Each hoist has a capacity of 4000 pounds at 80-psig pressure, thus giving plenty of power to aid the drills in fighting the partially broken, previously blasted ground, and each can handle up to 350 feet of ½-inch wire rope.

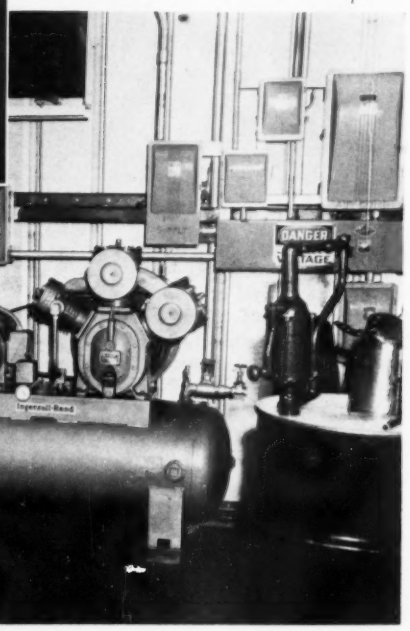
For leveling the barge and providing a stationary deck during drilling, the vessel is equipped with four heavy spuds, one at each corner. Powering these are I-R Model HHM stationary air motors. These piston-type drivers are rated at 9.5 hp each at a pressure of 90 psig and raise and lower the spuds through a mechanical gear linkage.

Hornet IV has been averaging a blasting rate of about one charge (approximately 500 pounds of explosives distributed among 20 holes) every hour and 45 minutes. Holes average about 9 feet in depth, and it requires about an hour to complete drilling. Part of the reason for the high blasting rate is the means provided for getting the barge away from the loaded holes prior to shooting, and then getting it back on range and in position for the next drill round. This is accomplished in an average of about 45 minutes by two winches, one at either end of the barge, that take-up and pay-out lines anchored to deadheads on the shore and in the river. Previous surveys along the shores have established sighting points, and the boat captain has only to bring his vessel to precalculated transit readings to properly align the towers. The winches are also powered by air motors (Ingersoll-Rand Model HH5M units, delivering approximately 11.5 hp when supplied with 90-psig air).

A complete cycle on the boat consists of drilling, loading, moving off range and blasting, and returning to the range, aligning the barge and leveling it. There are five drillers. All start at one end of the vessel, each operating one of the drills on the first five towers. As each completes his hole, he "leapfrogs" the other drillers and moves down the line to another tower. Thus, each driller puts down four holes per cycle. As each is completed, the powder men load it with approximately 25 pounds of explosives (60-percent gelatin dynamite) through the casing. Then the casing is lifted and the explosives are wired into a permanent blasting circuit on board the barge. When all holes have been completed and loaded, spuds are raised and the barge pulls off range. Because the channel must be kept open for the passage of ships, it is occasionally necessary to pull back between blasts.

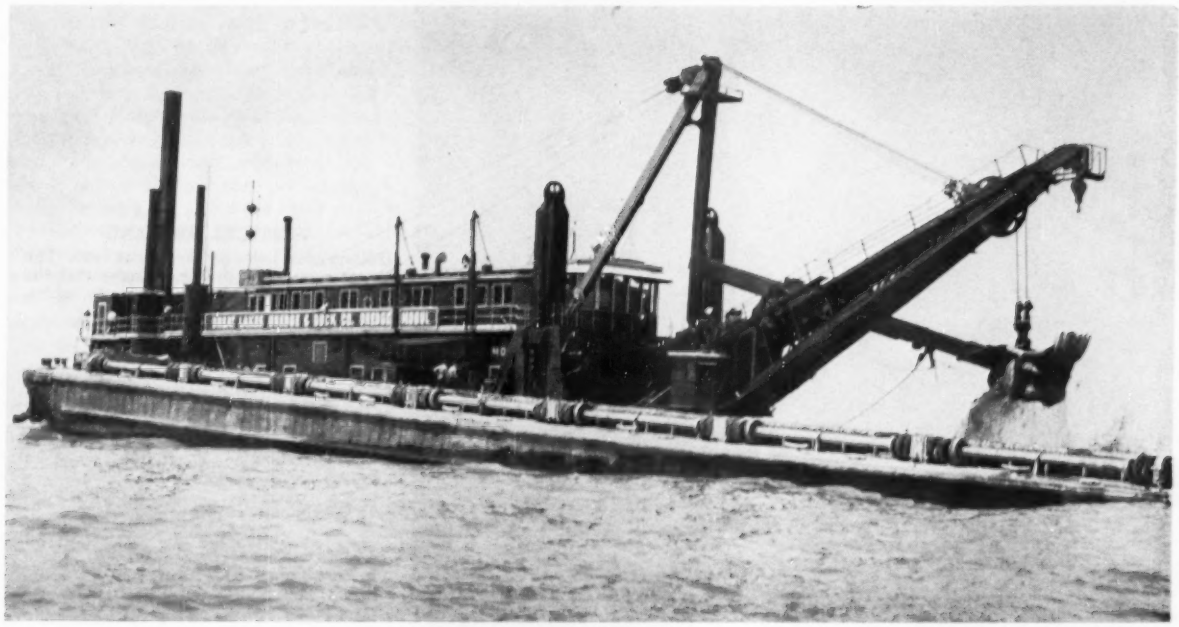
Air power for the *Hornet IV* is supplied by seven Ingersoll-Rand 900-cfm portable Gyro-Flo rotary compressors arranged for stationary mounting. Water-cooled heat exchangers replace the air-cooled radiators normally used for portable units, and a central fuel supply is also provided. Exhaust from the 300-hp General Motors 6-110 drivers is piped through flexible tubing to the roof of the compressor room. Air intakes for both engines and compressors, how-





COMPRESSORS

Seven Ingersoll-Rand 900-cfm Gyro-Flo portable compressors arranged for stationary mounting supply the air for all the boat's equipment. The view above shows these units. The tube-shaped device at the side of the machine in the foreground (Number 7) is the water-cooled heat exchanger that has replaced the air-cooled radiator normally used on these machines. Also visible is the I-R air-starting motor. Six of the seven units have air starting, the other is turned over electrically. Starting air is furnished by the 2-stage Ingersoll-Rand Type 30 compressor shown in the view at the right. Just above the compressor are shown some of the electrical controls for the barge, which is supplied by Kato 40- and 75-kw generating sets.



THE "MOGUL"

Great Lakes Dredge & Dock's dipper dredge "Mogul." The vessel is 156 feet long and has a 65-foot dipper stick that can handle either a 9- or 12-cubic-yard bucket. Both the dredge and "Drillboat No. 1" operate around the clock.

ever, are through the filters provided with the machines. Air is discharged at a nominal 100 psig through flexible metal hoses to a common manifold running the length of the barge. All drills, hoists and air motors are supplied from this line.

Air starting motors are provided on six of the seven compressors; the other is equipped with electric starting. Starting air is supplied either from the main line, or by an Ingersoll-Rand Type-30, 2-stage, tank-mounted unit. This machine is electrically powered. Electricity is supplied by two Kato light plants of 40- and 75-kw, also driven by GM diesels. A complete power circuit throughout the barge provides lights for around-the-clock operation. Three 18-man crews are required.

Dredging of the blasted material is being carried on by a barge-mounted Bucyrus Monighan 9-W dragline, and the spoil is being used, where practicable, in the construction of the compensating dikes that also are a part of the contract. The over-all contract, even though it lies wholly within Canadian waters, is under the management of the U. S. Army Corps of Engineers. Col. Peter C. Hyzer, District Engineer, Detroit District, is the contracting officer. Brig. Gen. P. D. Berrigan is Division Engineer of the North Central Division, Corps of Engineers, which has charge of the overall channel improvements program.

Marine Operators' project manager is R. E Englehart, J. H. King is general superintendent, Warren Larson is project engineer and G. W. Anderson is equipment superintendent.

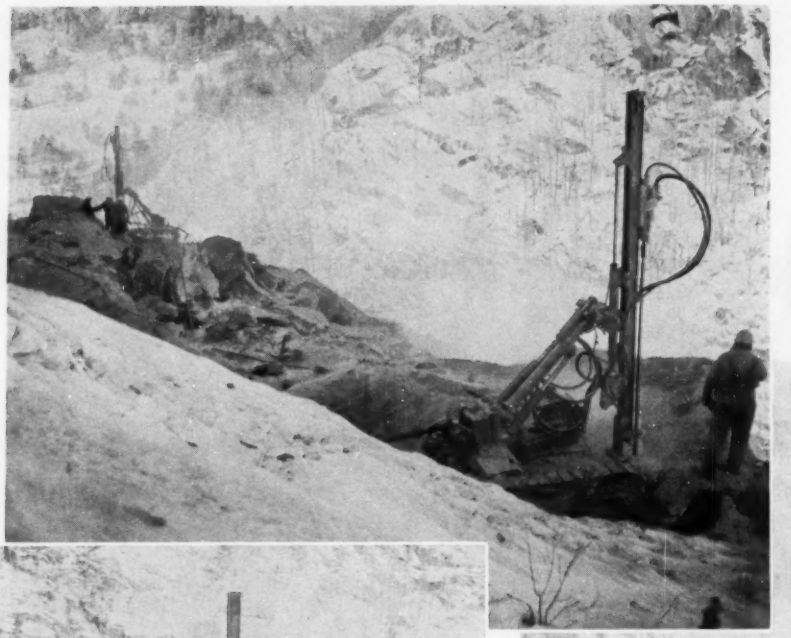
The portion of the Amherstburg project that is contracted to Great Lakes Dredge & Dock is being done by *Drill Boat No. 1* and the *Dipper Dredge Mogul*. Mel E. Lemmerhirt is project manager, and George Rhoads is project engineer. The captain of the dredge *Mogul* is Arthur Richard and Ellsworth Clabeaux is captain of *Drillboat No. 1*. That firm's contract covers roughly 2.5 miles of the work and is downstream from the Marine Operators' section. Bid in at a price of $6.6 million, the work is considerably more exposed to Lake Erie weather than is the section being done by Marine Operators.

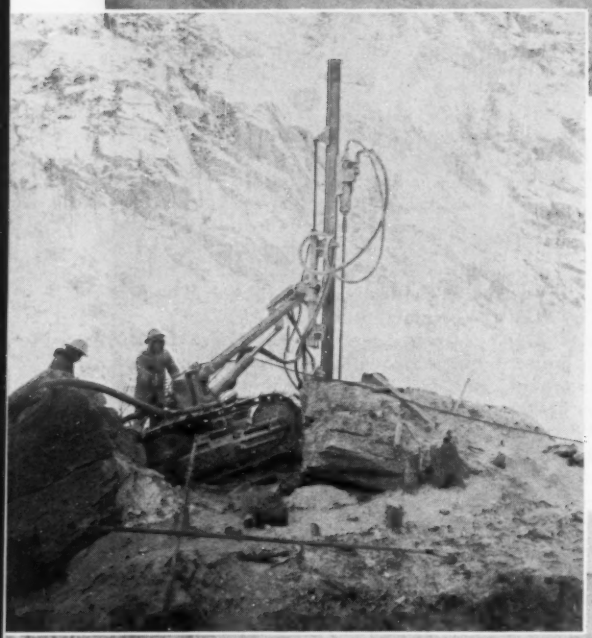
Drill Boat No. 1 is 140 feet long and is equipped with four Ingersoll-Rand SP8 submarine drills that are operated by steam rather than compressed air. The drill towers move on rails, being positioned by winches that spot them along the working edge. Twelve holes are drilled per round by *No. 1* and they are spaced on 10-foot centers. Carset (tungsten-carbide-insert) bits 4¼ inches in diameter are used. Holes average approximately 8 feet in depth and are loaded with 35 to 40 pounds of dynamite. Boiler rating of the power plant on *No. 1* is 160-psig working pressure. Air for blowing cuttings from drill holes is supplied by two Gyro-Flo portables of 600-cfm capacity.

The *Mogul* is a 156x42.5-foot vessel carrying a 65-foot dipper stick on which either a 9- or 12-yard bucket can be hung. It loads 1500-cubic-yard bottom-dump scows that are towed to disposal areas in Lake Erie. Both drilling and dredging go on around the clock. Drill crews travel back and forth to the boat from a shore-based field office, but some of the dredge's 35-man crew are housed and boarded on the vessel. The rest "commute" from shore.

Great Lakes engineers have worked out a unique method for spotting both the drill barge and the dredge. Land-based sighting points are few and far between at the point in the channel where the vessels are working, so the engineers erected their own. Work is progressing across half of the channel's width, thus leaving the other half open for ship transit. (Vessels pass through on the average of one every 15 minutes.) Near the center of the project, H-piles were driven and a cable strung across the half-channel at that point. At fixed intervals on the cable, vertical wooden slats mounting a colored light were suspended. Approximately 1000 feet downstream, a similar set was put in, except that fluorescent lamps were used. The rigs are positioned by aligning them with known pairs of lights. Range lights burn both day and night, regardless of weather conditions. On foggy days, however, they are visible for a greater distance than would normally be experienced.

At the present time, work on both contracts has been suspended for the season. As soon as the ice goes out in the spring (usually early this month) dredging will resume. As we have said, the work is expected to be done in 1960 so as to be ready for the start of the shipping season of 1961.





VERTICAL DRILLING

Drilling blast holes for the access road. The slope is so steep in some places that the Crawl-IR's are anchored to stumps by cables, as shown in these illustrations.

BALL MOUNTAIN DAM

New Structure To Provide Flood Relief For Connecticut River Valley

R. W. Sapora

ABOUT 29 miles north of Brattleboro, Vt., at the base of Ball Mountain, the West River narrows and flows through a gorge that has been selected by the Corps of Engineers, U. S. Army, as a site for a flood control dam. Excessive runoff, usually in the fall or spring of the year, periodically swells the West River to flood stage and, in addition to causing property damage and inconvenience to the residents of the immediate area, discharges into the Connecticut River at Brattleboro, contributing to the build-up of floodwaters in that river system. The Ball Mountain Dam is one of a number of structures being built on tributaries of the Connecticut River to provide more effective property protection from floods in the Connecticut River Valley between Westminster, Vt., and Long Island Sound.

Ball Mountain Dam will be an earth-rock structure 985 feet long, with a maximum height of 265 feet, and will provide storage for about 54,600 acre-feet of water. The reservoir area, except

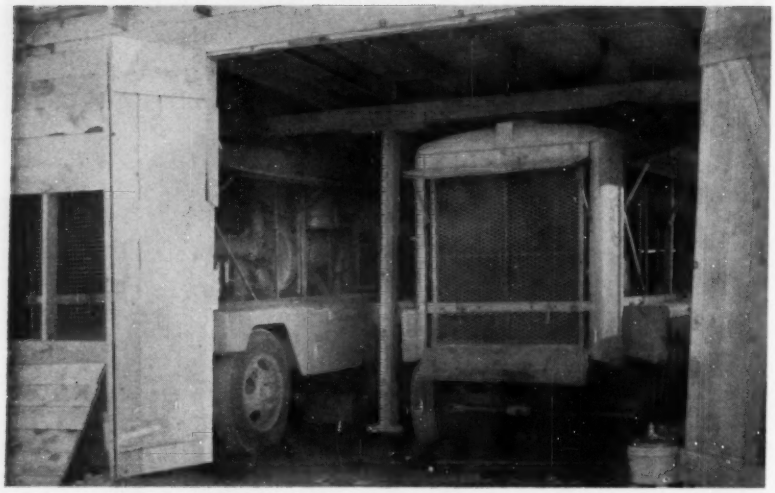
PHOTO, CORPS OF ENGINEERS

STARTING THE WEST PORTAL

As the tunnel heading was opened (right), doubtful areas above the portal were secured by roof bolts. The slot-and-wedge-type bolts were tightened by Ingersoll-Rand Torsion Bar Torque Control Impactools. In the tunnel heading, holes are being drilled with jumbo-mounted DB35 drills.

HORIZONTAL DRILLING

One of two Crawl-IR's on the job being moved into position to drill another blast hole into the side of Ball Mountain. The work will result in an access road that eventually will end in a turn-around and lookout point above the dam. The rock in the foreground is to be trucked to the valley below and used for fill at the base of the dam.



AIR BATTERY

Two 600-cfm Ingersoll-Rand portable Gyro-Flo (rotary) compressors supply air for the Crawl-IR's. A 6-inch line leads from the rear of the shack across 1200-feet of rugged mountainside to the drills. Two more Gyro-Flo's, both of 900-cfm capacity, supply air for the DB35 drills working in the tunnel. Another unit, working on the extension of the access road is shown below.

PHOTO, CORPS OF ENGINEERS

during flood stages, will usually be dry; however, in winter a pool covering about 10 acres will be maintained to prevent freezing of the control tower gates. Although there will be no development of recreational facilities as part of the project, the scenic beauty of the rugged mountainous area will remain unimpaired. The few temporary buildings presently being used will be removed when construction is completed.

A bypass tunnel, of circular section, to handle the normal flow of the river is being driven to a diameter of 15¾ feet in the south bank. When completed, it will be 935 feet long and lined with concrete to a diameter of 13½ feet. Both an inlet and outlet channel to the tunnel will be provided. An inlet tower equipped with gates will admit water to the tunnel and control the water level of the reservoir. The tunnel work has presented no unusual problems, except that the rock has proved to be an extremely hard gneiss. Present progress is at the rate of about 15 feet per day, with completion likely early this year.

Six Ingersoll-Rand DB-35 drills mounted on jumbos are being used to drill blast holes 8 feet deep and 2½ inches in diameter into the face of the tunnel. After these holes are loaded with Hercules Gelamite No. 1, the half-track-mounted rig carrying the drills is withdrawn from the tunnel, and the round is fired from a point outside and to one side of the portal. Approximately 300 pounds of explosives are used for each round, producing about 63 cubic feet of rock. Mucking is done with an Eimco 105 mucker, loading into trucks that dump the material along the river bank a short distance below the downstream opening of the tunnel.

Air for the drills is supplied by two 900-cfm Ingersoll-Rand portable Gyro-Flo (rotary) compressors located outside the tunnel entrance. The machines are manifolded to a 6-inch pipeline that extends a short distance into the tunnel, at which point it is reduced to 3 inches in diameter and continues on to the working face.

Fifty roof bolts of the forged slot-and-wedge type have been used so far to secure doubtful areas of the tunnel. These fasteners are 8 feet long and 1½ inches in diameter. They are tightened with a Size 5340T Ingersoll-Rand Torque Control Impactool.

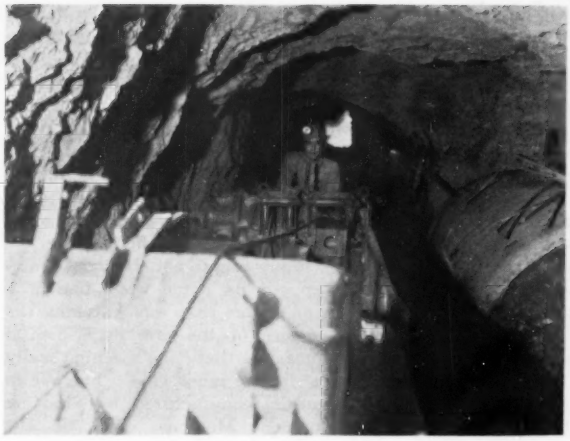
In order to reach the high point of the spillway excavation, an access road was constructed over the rough terrain. This road started from an existing road at elevation 1070 and climbed at a 10-percent grade to elevation 1180, the highest point of the spillway excavation. All rock excavation from the spillway is being hauled over this road and placed in the rock section of the dam, as required by the job specifications. Eventually, this access road will be incorporated into the final phases of the completed project and will serve to gain access to the bridge that services the control chamber of the intake tower. Blast holes for this job are being put down by two Ingersoll-Rand crawler-mounted drills. These self-propelled machines, called Crawl-IR's, are powered by two independently controlled, piston-type air motors. Completely mechanized, they convert time formerly spent in moving, setting up and steel handling into actual drilling time.

The Ball Mountain job furnishes an excellent example of how crawler-mounted machines greatly expand the field of wagon-drill operations. Here the Crawl-IR's have been worked into position under their own power over 1200 feet of rugged, boulder-strewn mountainside that is difficult enough for a man to cover on foot. The slope is so steep in the area where holes are being put down that both machines are securely anchored by cables to stumps or other safe anchorages.

Air for the drills is being supplied by two 600-cfm Ingersoll-Rand Gyro-Flo's through a 1200-foot pipeline. The terrain is too rough to permit closer placement of the compressors to the drilling area.

Approximately 40 three-inch holes are drilled to a depth of 30 to 55 feet for each blast in the extension of the access road and the spillway excavation, then loaded with Hercules Gelamite No. 1 and fired. Each round produces about 3000 cubic yards of rock. Fragmentation has been excellent, and little secondary drilling has been needed.

The latest approved cost estimate for Ball Mountain Dam is $11 million, with completion expected by December 31, 1960. Prime contractor for the project is Merritt-Chapman & Scott under the supervision of Jack Taylor, project manager, and Arthur Groyes, project engineer. Sub-contractor for the tunnel and all rock drilling and blasting is Rock Construction Corporation of Kingston, N. Y. "Sonny" Young is field superintendent for Walter Dunham, owner of the company. General supervision of the project is maintained by the Corps of Engineers, U. S. Army.



THE WHUP D'WHUP

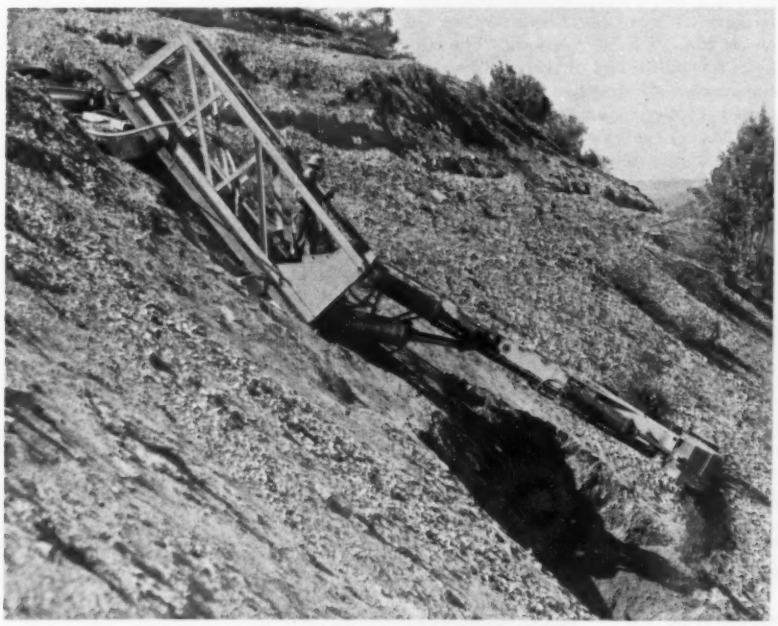
The two pictures above show the "Whup d'Whup" from either end. At the left is a view of the lead car which mounts an Ingersoll-Rand 2-drum air-motor-driven slusher hoist. The other view shows the trailing end of the train illustrating the interlocking aprons, grizzly rails and side-boards that provide a slusher way for the scraper bucket. The cars, it can be seen in this photo, are almost as wide as the bore because there is no need to switch cars in the heading. A single train carries all of the muck resulting from one round.

Compressed Air Has Role In—

MUCKING INNOVATIONS

OF RECENT years, two innovations in mucking have come to light that may result in increased efficiency and in over-all cost savings both for mines and tunneling projects. One operates in vertical or incline shafts; the other in horizontal headings. Both rely on compressed air for power.

The first machine is called the Cryderman Shaft Mucker. A development originating in Canada, the device has already found wide application in that country and now is receiving increasing attention in the United States and numerous other countries throughout the world. Essentially, it consists of a cage on the bottom of which is suspended, in a gimbal, a telescopic boom. On the end of the boom is a clam-shell bucket, usually of ⅜-yard capacity, although ½-yard machines have been constructed. Two air cylinders fastened to the gimbal and the boom control the movement of the bucket from side to side. Two more cylinders raise and lower it, a fifth is in the telescoping boom itself to extend and retract it, and an additional two units open and close the clam shell.



THE CRYDERMAN MUCKER

Shown in this view, taken out-of-doors, is one of the Cryderman Shaft Mucking Machines designed for use in an incline shaft. Seven air cylinders power the rig, and the motions of the telescoping boom can duplicate virtually all possible motions of the human arm. This is reputedly the first successful mucking development practicable in incline slopes.

The machine has certain advantages ascribed to it. For example, it can be adapted to incline shaft mucking, a job which normally, even today, is done by hand in bores at angles of more than about 30 degrees. For all practicable purposes, the Cryderman mucker duplicates all possible motions of the human arm. It reputedly can clean the bottom of a shaft faster than other methods, can operate in cramped quarters where previously work had to be done by hand and can load directly into buckets for hoisting to the surface. Furthermore, the clam can be used to position the hoist bucket at the bottom for maximum efficiency in loading.

The Cryderman machine has a cage 20 feet in height (built in two 10-foot sections for easier handling and set-up), and its boom is 17 feet long, retracted, and 32 feet long, extended. The boom can swing 14 feet to either side, and the cross-sectional measurements of the cage can be varied within limits to fit almost any size shaft. Two "joy stick" control valves regulate all movements of the boom and clam bucket. The operator is at all times in the cage, within full view of the bottom of the shaft, yet clear of

loading and hoisting areas. The machine can be attached directly by cable to a hoist, or, to permit direct operator control of raising and lowering, a tugger hoist can be mounted in the cage itself. (In the latter case, safety chains are secured to mine timbers when the cage is not moving.) It requires no special guides other than those normally used in a shaft for raising and lowering cages.

When used in an incline shaft, the Cryderman mucker can be equipped either with a clam bucket or with a backhoe-type shovel. In either case, compressed air provides positive control over the positioning of the loader and provides for a positive feed, or crowd, thus improving mucking efficiency.

Whup d'Whup is the name of the other mucking aid, and it is a means by which full trains of mine cars can be loaded without the need of cherry pickers, California switches or other forms of car transfers. It is a completely self-sufficient loading and haulage unit and consists of a rail-mounted, overshot, air-driven mucking machine; a string of integrated cars; and an air-operated slusher hoist and bucket. The complete train, which is made up specially for each job, consists of sufficient cars to handle all the muck resulting from one round, including the overbreak. Because the cars do not have to be switched in the tunnel, they may be wide enough so that they just pass the narrowest opening in the bore. The cars have overlapping aprons and grizzly rails, the latter extending the length of each car. Aprons and grizzly rails are about 12 inches below the sideboards of the cars, thus providing a slusher lane. On the lead car of the assembly is mounted a slusher hoist connected by cables through a bridle on the rear car to a bucket that just fits between the sideboards and that rides on the grizzly bars. The loader mucks into the rear car, and the slusher picks up the material at that point and distributes it the length of the train, filling each car to the rails. After all are that full, more material may be heaped to the capacity of the sideboards. After the round is completely mucked, the loader is hitched to the last car and a locomotive pulls the assemblage away from the heading.

It is interesting to note that the Whup d'Whup got its name when one of a group of miners that was watching the performance of the first experimental unit remarked that "the machine really 'whups' it (the muck) in." The Whup d'Whup is manufactured by Shaft & Development Machines, Inc., of Salt Lake City, Utah, which also has the American and South American manufacturing rights for the Cryderman machine.

1000 Feet Deep At The Bottom Of The World

DEEP drilling at the International Geophysical Year's Byrd Station in Antarctica has passed the 1000-foot mark. Ice cores taken from this drill hole preserve in their annual layers clues to Antarctic climate reaching back many centuries. Ernest Marshall, the glaciologist in charge, estimates that deeper layers were formed in the 1600's.

Development of techniques and equipment for deep drilling to obtain undisturbed cores was inaugurated on the Greenland Icecap in 1956, and continued and improved in 1957. The Byrd Station program began on December 16 and was fully operational on December 29 of last year when ice core study began. It is being conducted for the IGY by personnel from the U. S. Army Snow, Ice & Permafrost Research Establishment of the Corps of Engineers. By January 26, scientists had reached a depth of 1013 feet.

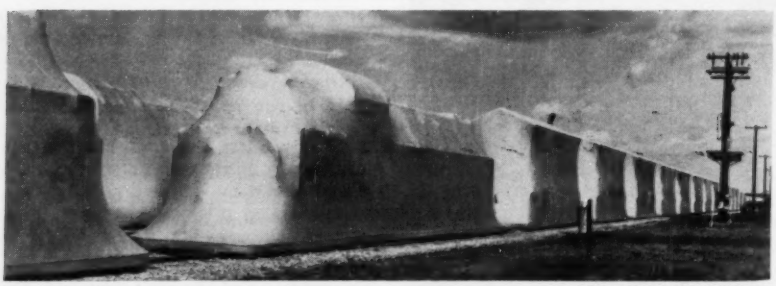
Some equipment for the Byrd Station project was brought in overland from Little America, 647 miles away; other necessities were dropped by parachute from U. S. Air Force Globemasters.

At first the job began with hand boring a 3-inch hole to a depth of 60 feet. Then a cold compressed-air drilling rig with specially designed core barrels and bits was put into service and a 4-inch-diameter coring drill has been used since. It permits the removal of unbroken ice pieces from 15 to 20 feet long. The cuttings are blown out of the drill hole by compressed air that has been especially cooled to the required temperature so that the core sample will not be melted. Extreme care must be taken to avoid shattering of the ice cores when they are removed from the great pressure that exists at depths of more than several hundred feet.

Because of the relatively small annual accumulation of snow in Antarctica, the ice 1000 feet below the surface at Byrd Station is roughly equal in age to ice at a 2000-foot depth in Greenland. However, the Antarctic cores are more difficult to date. In Greenland, annual layers of snow are generally marked by a thin crust of refrozen summer melt. The age of a core can then be read as one reads the age of a tree by its annual rings. In Antarctica, there is often little or no summer melt, and the annual layers are thinner and more closely packed. Careful chemical analysis may eventually be needed to date the deep-lying ice.

Upon withdrawal, each core is cut in half. One section is forwarded to the research establishment's Wilmette, Ill., facility; the other is melted and filtered to discover any minute particles that might appear in it. They are broken into 3-inch units for density measurements, visual examination and determination of yearly accumulation whenever possible. Microscopic examination and photography of thin sections of ice at different depths will permit studies of crystal structure and more accurate relation of age to depth. Selected portions of the cores are to be melted and filtered for study of the minute particles and primitive organisms that may have been trapped in the ice for hundreds of years.

Volcanic ash from the eruption of Katmai in 1912 has been found in cores taken from the Greenland ice, and it is expected that similar ash and other matter, perhaps from much earlier periods, will be found in the Byrd Station cores. Later this year, when summer again returns down below, a similar project is planned for what is known as the Ross Ice Shelf.



PHOTO, ALUMINUM BULLETIN

PICKLED LOCOMOTIVES

Shining in the sun in Ogden, Utah, are "pickled" locomotives. The Corps of Engineers, U.S. Army, placed these engines on metal pans and placed osnaburg cloth over them. Coats of plastic and tar were then sprayed over the units, and finally a layer of aluminum paint was applied to form weather and temperature-change protection. According to The Aluminum Association, the average cost of "mothballing" a unit is $2200. They are readily available for service, and thus represent a considerable saving over building new locomotives to meet changing demands.

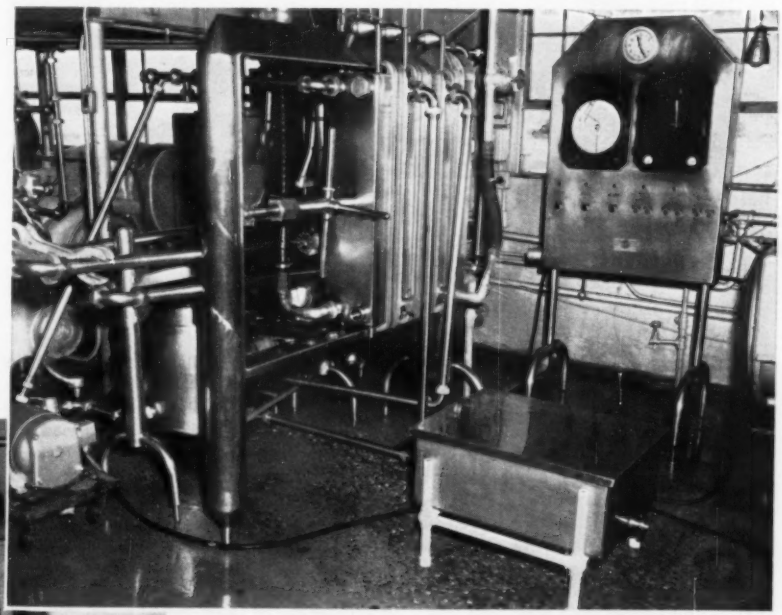
Air Controls Aid Milk Pasteurization

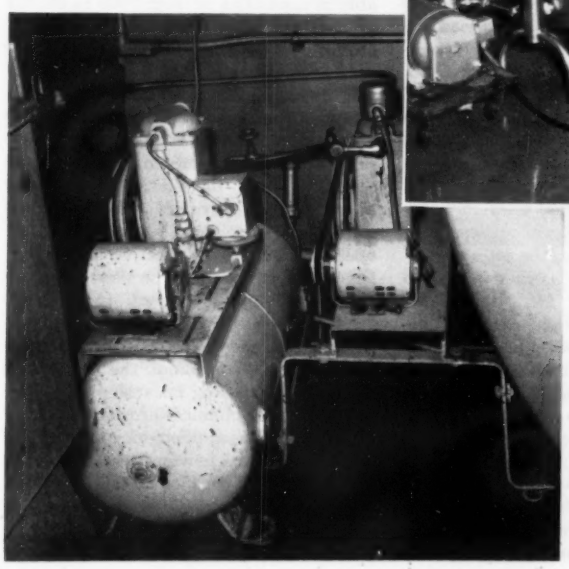
LOUIS Pasteur guaranteed a safe drink for youngsters and grownups alike when he developed the process for semisterilizing milk that even today carries his name. Pasteurization is almost universally applied to fresh milk sold in this country as well as to that of most other countries in the world. Essentially, it prevents the rapid fermentation of milk by destroying many of the bacteria that are responsible for "souring." Webster defines it as the partial sterilization of a fluid at a temperature that does not greatly affect its chemical composition and thus its flavor.

In past years, milk normally was pasteurized in batches, rather than as a continuous-flow step. The fresh milk was run into a vat where it was held for a period of approximately 30 minutes at a temperature of 145°F followed by rapid cooling to below 50°F. Indeed, much of the nation's milk supply is still treated in this fashion. In an effort to speed up the process, however, and increase the operating efficiency of dairies by providing for a continuous-flow process rather than a batch operation, scientists determined that holding the milk at a higher temperature for a shorter period of time—specifically 165°F for 19 seconds—would have the same results as the vat method while not appreciably, adversely affecting the end product.

Thus it is now possible for dairies to process their milk in a continuous-flow operation. It is not difficult to design a tube maze through which it takes milk the required length of time to flow. It is slightly more difficult to provide a means for maintaining, within very small limits, the required temperature of 165°F however, and it is at this point that compressed air comes to the fore. Responding instantaneously to signals from temperature-sensing devices, air is used to operate the control valves that admit steam to the pasteurization equipment. The air also operates recorders that provide readily visible proof of the operations of the sterilizing equipment. Oil-free air is most commonly used because it is clean and dry and free from oil carry-over that might get into small orifices and cause faulty operation of the delicate control equipment.

In operation, the short-time pasteurizer, as it is known, is brought up to temperature by admitting steam to accordion-like metal pleats where intricate passages direct it in a counterflow stream past the milk passages. After the equipment is up to temperature, milk is admitted at a carefully regulated flow-rate to assure that it remains at the specified temperature for the required time, but no longer, for that would adversely affect the flavor of the milk. As the milk enters, the equipment, of course, begins to cool rapidly. That change is sensed by a temperature-measuring device and a pneumatic signal is sent to the controller where the pressure change actuates a valve admitting compressed air to one side of the diaphram of the steam-flow valve thus admitting more steam to the pasteurizer. When the temperature again reaches the desired point, the signal from the sensing device is altered so that the steam valve is adjusted to maintain the optimum conditions. A raise in temperature above the required point initiates a reverse step with the steam valve closing. The reaction time of the pneumatic system is considerably less than that of a human being and more adaptable to fine "tuning" or adjustment than other forms of control. The end result, as observed from the inked, record chart printed with each milk run, is that the temperature is maintained to within but 1-2° of the required 165°F.

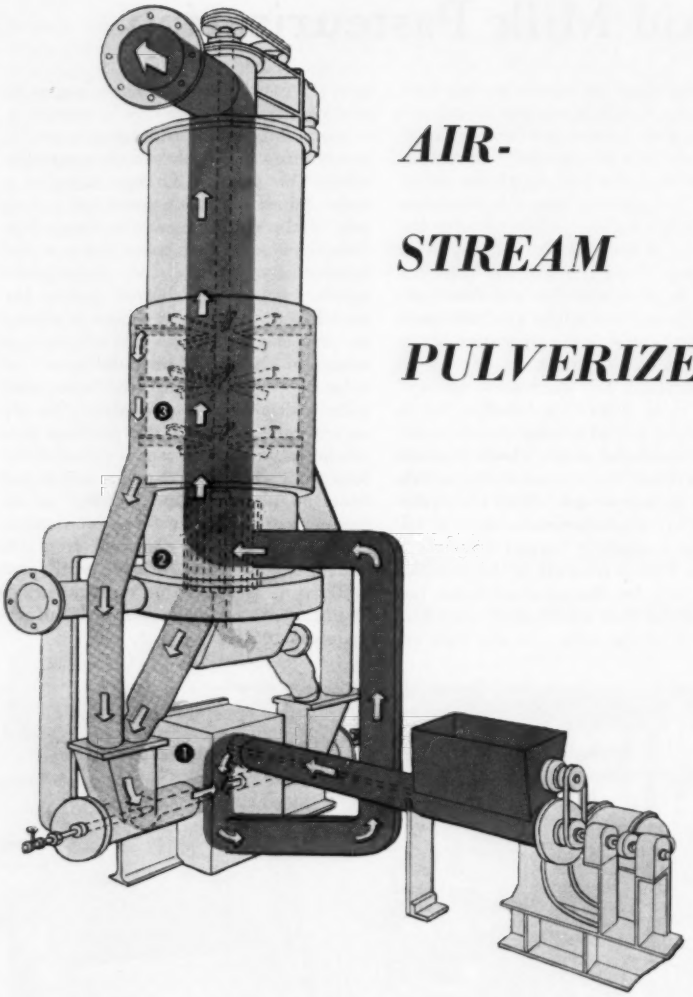




SHORT-TIME PASTEURIZER

At the Cream-O-Land Dairy, New Brunswick, N. J., a short-time pasteurizer is installed to handle that firm's daily output of some 14,000 quarts of milk, put up both in glass bottles and paper cartons. The pasteurizer and its control equipment are shown in the picture above, and the air supply for the dairy, in the other view. (Oil-free air is utilized for agitation as well.) The pasteurizer is the gleaming stainless steel assembly at the left, and consists of a maze of accordion-like metal pleats through which steam and milk are counterflowed. The pleats slide on rails, being forced into position by the hand wheel in the center of the assembly and thus can be separated for cleaning and sterilization after each day's run. The controls are made up of the recorder (left) and the temperature indicator (right). Pneumatic signals open and close the steam inlet valve thus maintaining, within close limits, the temperature of the pasteurizing equipment.

AIR-STREAM PULVERIZERS



THERE is a growing use for compressed air in a type of pulverizer that depends on the attrition resulting from high-speed impacts between particles of the material to be ground. The high velocities required are induced by opposing jets of compressed air that entrain solids and hurl them into head-on collisions. Pneumatic power also serves as the transportation medium within the pulverizer and as an aid to classification of the particles as well.

A Majac Jet Pulverizer is such a unit, and its method of operation is depicted in the accompanying sketch. The actual grinding is done in the chamber, numbered (1). Here, two directly opposing air streams meet. Entrained particles, fed from the hopper in the right foreground by a screw conveyor, impact against each other, and also collide with recycle material from the stripping zone (2) and the classifier (3).

All particles fall from the attrition zone and are sucked up to the stripping chamber by a fan-induced draft. There, any moisture present in the raw material can be removed by flash-drying, and the heaviest particles fall back to be reëntrained and jetted again. The remaining, or lighter particles, are carried up to the classifier where power-driven blades intercept oversize (overweight) bits and hurl them to the periphery of the shell where they drop back to the jets. Material of the required size is passed through the classifier and is ejected at the top.

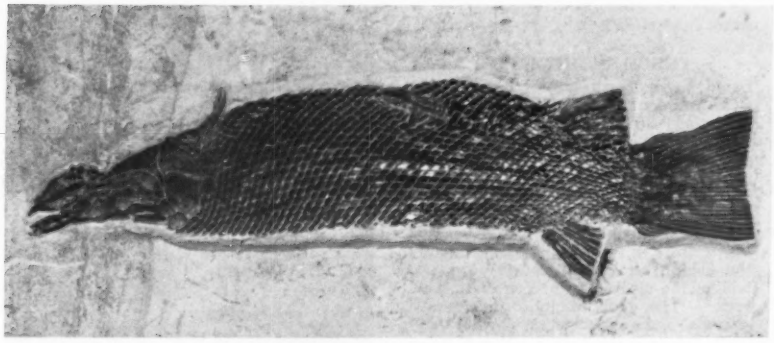
Fineness of the finished product is determined by the distance between the muzzles of the jet guns, the jet-air pressure, speed of the classifier and the quantity of stripping air. It is also possible to obtain particle size distribution, that is, varying percentages of a number of different sized grains. The largest particle size is determined by adjusting the volume of stripping air (the greater its volume, the more heavy particles carried through the classifier) and regulating the speed of the classifier (the slower it travels, the fewer the heavy particles that are rejected). The fine particle size is determined by the jet-air pressure (the higher it is, the finer the grind) and by the proximity of the jet muzzles (the closer they are, the greater the attrition). Finish grinds as large as ¼ inch or so small as to be in the low-value micron range are possible, it is said.

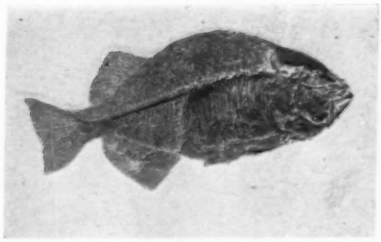
The pulverizers are of welded construction, fabricated of steel and, if a very abrasive product is to be ground, lined with ceramic tiles. Internal wear is inherently low because infeeds, not mill surfaces, do the actual grinding. Iron pick-up is said to be as low as 0.02 of 1 percent of the end product. If desired, mills made of stainless steel or having rubber linings can be furnished. Not only the special machines, but standard units have low maintenance costs. One utility reports that a jet installation cost only 28 percent as much to keep up as did a mechanical unit. In addition, because the mills operate mainly as closed systems, the operation is reportedly dustless.

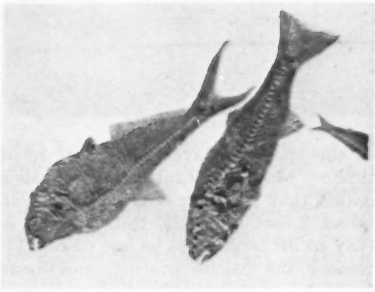
Besides grinding steps, the Jet Pulverizer will perform drying, mixing, coating and exfoliation steps as well. (Exfoliation is the opening up of fibrous materials such as asbestos.) Not only compressed air can be used, but steam and other gases as well. For example, in grinding materials that readily oxidize, an inert gas may be required to prevent chemical alteration of the end product. On the other hand, by proper control of the jet atmosphere, some chemical reactions can be carried on at the same time as grinding and without adding greatly to the cost of the operation. Drying has already been mentioned, and it is possible to control the moisture present in the finished grind within fairly close limits. Blending of two different materials can also be accomplished in the units.

The Majac Jet Pulverizers are available in capacities of from 1000 to 30,000 pounds per hour (based on pounds of coal pulverized per hour to a fineness such that 90 percent of the end product will pass a 200-mesh screen). The smallest mill requires an input of 90 cfm of compressed air at 100-psig pressure and at temperatures ranging to 800°F. Larger installations require as much as 4500 cfm of air. Besides heated air, which makes for more economical operation and more effective drying, refrigerated air can also be used to grind materials, such as resins, that might grow sticky or even melt at higher temperatures. Indeed, in such cases the air-stream method is about the only feasible way of grinding because of the heat build-up in mechanical crushers.

Man has thus applied one of the oldest and most erosive powers of nature to his own problems, thus providing more effective grinding of the products of mines, mills and chemical and petroleum plants.

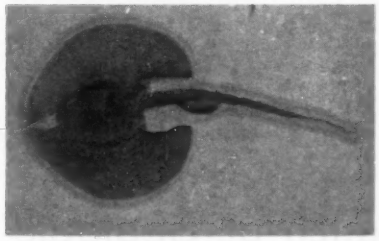


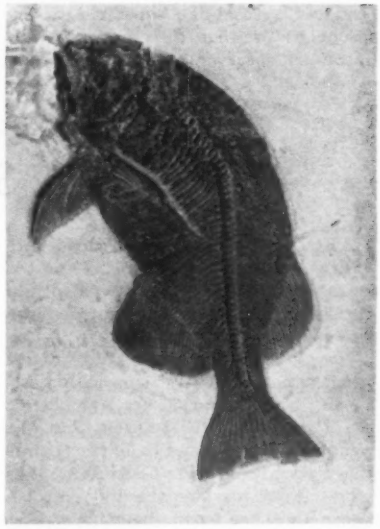




VARIETY OF SPECIMENS

Some of the various specimens that have been brought out of the Haddenham quarry operation are shown here. At the immediate right is a plaque with fossils of a bass and herring. Beneath it, and at the upper right, are 30-inch-long Dopedoglossus-Testis, and above is a framed slab with a 42-inch-long Gar-pike embedded in it. A similar one is in Princeton University's museum, Princeton, N. J. The other picture (below right) shows a sting ray. At the bottom of the page is a sign pointing to the tourist attraction and telling something of the operations.





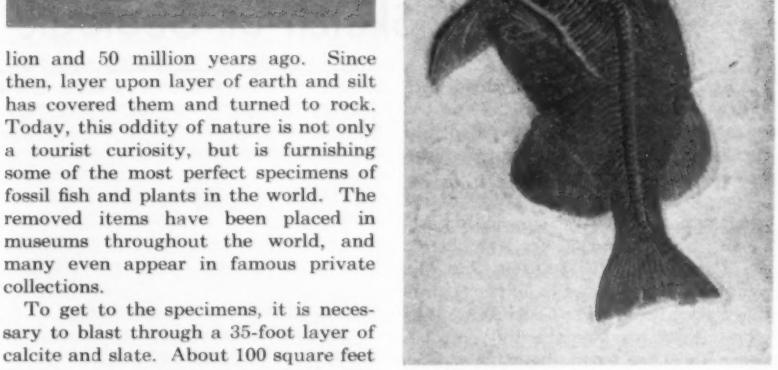
FISHING FOR FOSSILS

FISHERMEN who have become bored with the normal methods of angling might find fishing with picks, shovels, crowbars, wedges and blasting powder a pleasant diversion. Sounds impossible, but that is what is being done by two gold miners, David F. and D. C. Haddenham near Lander, Wyo.

Calcite cliffs, nearly a mile long, stand out in bold relief in a fossil district near the father-son operation. To the trained geologist, the various layers represent different stages of time. The field itself is one of these strata and is 10 to 14 inches thick. There is some confusion as to how it was formed. Some believe that southwestern Wyoming was once a large, tropical body of water called Lake Gosiute, and that during the Eocene Epoch, the fish the Haddenhams are finding today were embedded in the fine silt. Where there are great numbers of them, the theory is that they were caught in times of flooding rivers. The fish were dumped into the deltas of these rivers, along with the silt, so rapidly, they were covered with debris before they could swim to safety.

All of this took place between 35 million and 50 million years ago. Since then, layer upon layer of earth and silt has covered them and turned to rock. Today, this oddity of nature is not only a tourist curiosity, but is furnishing some of the most perfect specimens of fossil fish and plants in the world. The removed items have been placed in museums throughout the world, and many even appear in famous private collections.

To get to the specimens, it is necessary to blast through a 35-foot layer of calcite and slate. About 100 square feet


WONDERFUL-WYOMING
FOSSIL FISH DEPOSITS
Believed one of largest deposits of fossilized fish in the world from which are taken many rare specimens every year.
The formation tertiary geological age of these specimens about forty million years. Evidence operations may be seen working line near the top of breaks either side railroad. Fish are being mined from these deposits continually; tourists visit workings, at the breaks or at the paleontological studio located here. Tourists and visitors always welcome.
Wyoming also encompasses some of the most extensive fossil beds of dinosaur and early mammal skeletons in the world.
The "Oregon Trail" passed through this immediate vicinity.
WELCOME TO LINCOLN COUNTY

FOSSIL FISHERMEN

David F. Haddenham and his father, D. C. Haddenham, near the site of their operations (left). The desolateness of windswept Wyoming, 7000 feet above sea level, can be clearly seen. It is difficult for one to believe that once this was a lush tropical lake. Together, the Haddenhams have a combined fossil-fishing experience of nearly 100 years. The picture at the right shows some of the fishing equipment that is used as well as the clearly defined strata in the rock. The tools include crowbars, shovels, picks and blasting powder.

of the specimen layer is exposed at a time. Mother Nature has provided seams that run across the stratum at about 2-foot intervals, thus making it easy to lift large slabs as one piece. To remove the calcite coating, specimens must be painstakingly and tediously scraped. Because of this coating which produces a rosin-like substance, many specimens are not discernable to the untrained observer and can be easily overlooked.

Some of the fish that have been brought out are illustrated on these pages. Other than the fish, palm leaves, from 6 to 8 feet in length and from 3 to 4 feet wide, have been uncovered. The occurence of these confirms the geological theory that the climate was tropical and quite unlike the blizzard-ridden mountains of Wyoming today. This theory was further substantiated in 1890 when an alligator was found. It was discovered in thirteen pieces and when assembled, formed a 13-foot-long specimen. Several Gar-pike, ranging in size from 4 to 6 feet, have been disentombed, as have birds of about the size of the domestic chicken and resembling the snipe or plover in general conformation. In addition, specimens of sunfish, rasp tongues, deep sea bass, chubs, pickerel and herring have been found, not to mention mollusca, crustaceans, birds, turtles, mammals and many varieties of insects.

A Sketch of Geologic Time

GEOLOGIC history is divided into five sections called Eras. For the most part, each of these is divided into Periods, each of which is subdivided into Epochs.

The Eras are referred to by some specialists as the Archaeozoic (or Archean), the Proterozoic (or Algonkian), the Paleozoic, the Mesozoic and the Cenozoic. Others refer to all time before the Paleozoic as Pre-Cambrian, thus more clearly marking the difference between the time when the earth's rocks were being formed and the beginning of life. These divisions can be more accurately realized in the accompanying table which is based on the nomenclature adopted by the International Geological Congress. References throughout this section will be made from the terms given in the table, although it is interesting to note that some geologists do not consider the Quaternary as a distinct period since modern, or historic, time begins at the end of the Tertiary. We are living in the Quaternary Period.

The rocks formed during the five Eras constitute *groups*, those of the Periods, *systems*, and during the Epochs, *series*. They are the same throughout the world and are arranged in the same order, the oldest being the bottom strata. Most historical geologists have studied the formations of Europe and North America, thus these are the best known. Certain geographical sections have been

NORTH AMERICAN GEOLOGIC TIME*

ERAS	PERIODS	EPOCHS
Cenozoic *Age of Mammals*	Quaternary	Recent
		Pleistocene (Glacial)
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene
Mesozoic *Age of Reptiles*	Cretaceous	
	Comanchean	
	Jurassic	
	Triassic	
Paleozoic *Age of Amphibians, Fishes and Invertebrates*	Permian	
	Pennsylvanian	
	Mississippian	
	Devonian	
	Silurian	
	Ordovician	
	Cambrian	
Proterozoic (Algonkian)		
Archaeozoic (Archean)		

*For the sake of brevity and clarity, only those subdivisions mentioned in this and the accompanying article are given.

further subdivided and have been given names of the section, as the Lafayette, De Soto and Fernando formations of the North American Atlantic and Gulf Coastal Plains, Florida and California, respectively, as is the Green River section mentioned in the article. The rock in which the Haddenhams are quarrying their fossils is of the Eocene Epoch, the formations being known as the *Eocene Series*.

THE CENOZOIC ERA

The Cenozoic, or Age of Mammals as it is often called, was a time of great deformation of the earth's crust. In the United States, there was vast volcanic activity. It was during this time that the Cascadian Revolution was initiated, uplifting the North American Pacific Coast ranges and the Colorado plateaus. Cutting of the Grand Canyon began as did the formation of the volcanic mountains, Rainier, Shasta and Lassen.

THE TERTIARY PERIOD

The fossil remains that are found near Lander, Wyo., are of the Tertiary Period. It was named by G. Cuvier and H. Brongniart in 1810 as a result of their expansive study of fossils in what is known as the Paris Basin, France. This basin is made up of the valleys formed by the Somme, Seine and Loire rivers, and is one of three such geographic basins that make up France. The faunas there consisted very largely of Mollusca of modern aspect, and upon the percentages of recent species found, Charles Lyell founded, in 1852, the main subdivisions of the Tertiary—the Eocene, Miocene and Pliocene epochs. Later, a fourth division was named, the Oligocene, for the time between the Eocene and the Miocene. To simplify these subdivisions, the Tertiary has also been divided into two portions: the Older Tertiary, or Palaeogene; and the Newer Tertiary, or Neogene, including the epochs of the Pliocene and the Miocene. During the Older Tertiary, the great mountains of the world were formed—the Alps, Himalayas, Rockies and the Andes. It is believed that there were oceanic troughs where these mountains stand today. Hence, the face of the world changed radically during this time and came to look more as it does today.

During the Mesozoic Era, reptiles ruled the earth; however, during the Tertiary, mammals began to be supreme. Near the end of the period, just before the Ice Age, or Glacial Age as it is called by some, the earliest forms of man began to evolve. Snakes and birds that began to resemble those of today came onto the scene, and bony fish and crab-like decapods increased in number and variety. The period extended from a time estimated at 60 million years ago and ended sometime between 600,000 and a million years ago.

THE EOCENE EPOCH

Weather during the Eocene Epoch was quite unlike that we experience today. The middle latitudes were somewhat warmer than they are at the present. Near the end of the period, they became very much warmer, as evidenced by beds of fossil plants that could only flourish in tropical climates. Indeed, some of the remains that are uncovered in Lander are of large palm-like leaves, 6 to 8 feet long and 3 to 4 feet wide. Fossils such as these have been found as far north as the Arctic Circle.

This and That

Australian Charcoal Iron

Approximately 14,000 tons of iron made from charcoal was produced in Australia last year, and nearly 10,000 tons was exported. Its value was put at $780,000. Coming from the Wundowie area in the Darling Ranges, about 15 miles from Perth, Western Australia, the exported charcoal iron is in wide demand for certain specialty products. Supplies to the world are rationed because of the heavy demand, and the pig sells for an average of about $75 per ton. Currently a $1,800,000 expansion program is being carried on that will boost the area's production of the commodity to about 36,000 tons, of which 30,000 tons will be exported. Even at the expanded rate of production, enough iron and wood is available at Wundowie to last, respectively, for 1000 and 40 years, it is estimated. Japan is said to be the largest purchaser of the specialty iron, largely because of her ship building industry.

★ ★ ★

Rubber-Jointed Highways

Development of a unique, rubber expansion joint, designed to eliminate the rhythmic road shock motorists encounter on many highways and to make smoother aircraft landings possible on airport runways, has been announced by B. F. Goodrich Industrial Products Company. The joint is made of a man-made rubber especially compounded to absorb movement of the highway or runway in cold and warm weather. A series of metal plates are bonded to the rubber to carry the vertical loads imposed on the joint

by traffic. Reportedly, it permits as much as 3 inches of contraction and expansion while keeping the rubber flush with the surface.

Anchored between road sections for a water-tight seal, the joint is about 13 inches wide and extends the width of the highway or runway, completely filling the joint connection to its required depth. Originally developed for the Jones & Laughlin Steel Corporation's new prestressed concrete highway, the rubber expansion joint is also being designed for use on bridges and bridge approaches. Many people connected with the federal highway construction program have expressed interest in the product, and a number of states are planning to use it in experimental highway sections.

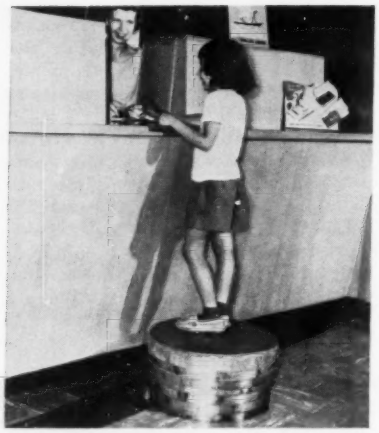
Second Highest U.S. Dam

An event of some significance recently took place on the Colorado River—the beginning of the construction of what will be the second highest dam in the United States. Glen Canyon Dam, as it will be called, will be 700 feet high and will be located on the Glen Canyon Unit of the Colorado River Storage Project in north-central Arizona. At the same time, work is beginning on a high bridge that will span the Colorado River near the downstream toe of the dam. Of steel arch construction, it will be the highest and second longest of its type in the United States. According to the U. S. Department of the Interior, a Government community will be built near the dam site at Page, Ariz.

★ ★ ★

Altimeters Test Mine Ventilation

According to a recent publication of the U. S. Department of the Interior's Bureau of Mines, altimeters that are commonly used to determine elevations can be used to check the efficiency of mine ventilation systems. The devices were tested in several coal mines where the experimenters discovered that the sensitivity of the instruments to changes in air pressure could be translated to reveal losses in ventilating efficiency. The reliability of the devices depends, of course, on their proper use and the correct interpretation of the data



BANKING MADE EASY

Adults rarely realize what difficulty youngsters have in feeling as big as Dad. A cashier at the First National Bank of Geneva, Ill., decided to do something about it for his pint-sized customers. At his suggestion, a platform that is raised and lowered by a hydraulic cylinder was installed in front of the teller's window. At a touch of a button, Junior is whisked 12 inches above the floor. The device was made by Miller Fluid Power Division of Flick-Reedy Corporation. It is 20 inches in diameter and consists of a telescoping stainless steel skirt that is moved by the cylinder installed under the floor.

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they reveal as compared with data furnished from associated instruments. The Bureau's report contains facts intended to guide ventilating engineers and others responsible for developing and maintaining more efficient methods for directing air through mines. The altimeters indicate inefficiencies caused by narrow passages, roof falls and the like. G. E. McElroy and D. S. Kingery, who authored the publication, list several "do's" and "don'ts" in the use of altimeters, and have compiled charts, scales and formulae to guide users.

★ ★ ★

Helicopter Powered By Air

The Aviation Division of the Fiat Motor Company, Turin, Italy, has announced the development of a helicopter whose rotor is turned by compressed air rather than a mechanical drive. Generated by a 530-hp turbo-compressor, the air is piped through the interior of the rotor blades and is ejected tangentially from the tips, thus spinning the rotor at high speed. The projected craft is designed to carry a pilot and six passengers, or their equivalent, in a pay load approximating 1760 pounds. It will have a top speed of 105 mph, cruising at 85 mph; a ceiling of 10,200 feet; and a range of about 190 miles, it is said. It will have an unladen weight of 3080 pounds Fiat points out that such a unit should have low maintenance and operating costs because there is no complicated and delicate drive mechanism such as the ones used on helicopters now in production.

★ ★ ★

Coffee Beans Take To The Air

In an effort to cut costs and increase production, J. F. G. Coffee Company, Knoxville, Tenn., is transporting green coffee beans from its warehouse across a busy street by means of an air pipeline to its processing building. Formerly, 130-pound bags, kept at the warehouse, were loaded onto small trackless trains that carried them across the thoroughfare. When they arrived at the processing building, each car of the train had to be taken by a freight elevator to the fifth floor where the bags were stacked beside roasters. As needed, the beans were dumped from the bags into blenders and were then moved to the roasters.

Now, beans are emptied from the bags into a cleaning hopper at the warehouse and are moved to blenders that are now installed there. After this operation has been completed, they are stored in a 10,000-pound-capacity storage bin. This area is equipped with an intake hopper which guides the beans into the conveyor. The air line spans a 150-foot distance between the warehouse and the processing plant. It has a 4½-inch diameter, and delivers the green beans to a receiver on the roof. The beans are then separated from their carrying medium and are fed to the roaster through a screw conveyor. It has been estimated that handling costs have been reduced by 50 percent since the new air system was installed.

★ ★ ★

Earth's Stellar Generator

C. Stellarator Associates is a new and unusual combined engineering staff that has been established by Allis-Chalmers Manufacturing Company and the Radio Corporation of America to design and build a facility at Princeton University, N.J., for advanced research into controlled thermonuclear reactions. The installation, known as the Model C Stellarator, derives its name from the fact that the device may eventually produce energy by a fusion of power, much as it is known to be done on the sun and stars. These can be thought of as stellar generators, or stellarators. The installation is based on an original concept of Dr. Lyman Spitzer, Jr., and is scheduled for completion in 1960. Since 1951, an Atomic Energy Commission-sponsored program has been headed by him at Princeton with the objective of exploring means

JUMBO

The jumbo-sized, automatically operated slide rule illustrated above is offered as proof that automation begins at home. Designed by engineers at Minneapolis-Honeywell Regulator Company, it performs its mathematical steps with push-button ease. An electric motor triggers a small "brain" that maneuvers the 3-foot-long device into calculating position. The unique computor was developed as a gift to one of the company's factory managers who is shown here operating his present.

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to harness the energy of nuclear fusion for peaceful purposes. Successful generation of such power from controlled reactions might prove to be one of the most significant advances in history. The device will comprise a gas discharge in which it is hoped to generate temperatures as high as many millions of degrees, thus eventually providing data necessary to design still more powerful units directed toward the planning of fusion-power reactors. These would be free of the radioactive wastes that result from uranium or plutonium fission.

★ ★ ★

Ice Island T-3

In the Arctic Ocean, a group of IGY scientists is occupying an island of ice. Named T-3, the island, formed from freshwater shelf ice, was first occupied by U. S. Air Force personnel in 1952. It was reoccupied by IGY men in May 1957, and the camp was named Station Bravo. The island has experienced temperatures of as low as minus 64° and as high as 23°F. It floats from place to place in the Arctic. On January 2, for example, its position was listed at 80°39' N., 112°55' W. A series of high winds occurring later that month, however, moved it considerably to the east. Extensive programs in meteorology, aurora, oceanography, ionospheric physics, gravity, marine biology and glaciology are

being carried on by scientists stationed on T-3 as well as on another ice pack station known as Alpha. The latter is formed of sea ice. Earlier in the IGY, a previously unknown underwater mountain range was discovered by personnel on Alpha.

★ ★ ★

Cuban Nickel-Cobalt-Ore Concentrator

Plans for the largest synthetic hydrogen sulphide plant ever built have recently been announced. It is to be a key unit in a $119 million nickel-cobalt project being constructed by Cuban American Nickel Company, a subsidiary of Freeport Sulphur Company. The firm has authorized Girdler Construction Division of National Cylinder Gas Company to engineer and equip an automatic plant to produce 60 tons per day of liquid hydrogen sulphide for its ore-concentrating facilities at Moa Bay, Oriente, Cuba, as well as one to produce 1,500,000 cubic feet of hydrogen per day as raw material for the hydrogen sulphide plant. It will provide storage facilities for both hydrogen sulphide and the liquid butane which will be raw material for the steam-hydrocarbon-process hydrogen plant. Limonite ore, averaging 1.35-percent nickel and 0.14-percent cobalt will be mined near the Cuban plant where it will be concentrated by chemical means to produce a nickel-cobalt sulphide to be shipped to the United States refinery. The nickel refinery will be at Port Nickel, La., not far from New Orleans, and will have a capacity of 50 million pounds of nickel and 4,400,000 pounds of cobalt each year.

Construction of an automated on-site plant to supply the unusually large quantities of hydrogen sulphide required for the Moa Bay ore reduction process is a joint result of Girdler's initial research and design of a 1500-pound-per-day unit. Its development, company officials said, satisfied the need for hydrogen sulphide in quantities not practical or economical to handle by cylinders, and in locations where bulk supplies are not available. Production is scheduled to begin sometime during the summer of 1959.

★ ★ ★

Rockets Into The Auroras

Five successful firings of Aerobee and Nike-Cajun high-altitude research rockets were reported recently by the IGY Committee of the National Academy of Sciences. They are a part of the International Geophysical Year program of upper atmosphere studies and were conducted at a specially built rocket launching site at Fort Churchill, Canada. This location is particularly valuable for IGY studies because it lies well within the zone of maximum auroral intensity. It was built by the U. S. Army Corps of Engineers and is managed by the U. S. Army Ordnance Corps with coöperation from the Canadian IGY committee and the Canadian defense establishment. The vehicles carried their instrument pay loads to heights ranging from 58 to 130 miles where the devices measured air pressure, temperature and density of the high altitudes. Of the five launchings, the second went the furthest. It carried a 243-pound pay load directly into an auroral display. It is expected that the data gathered by the instruments carried in that rocket will give scientists much additional information about the nature and formation of auroras and their relations to other events in the high atmosphere.

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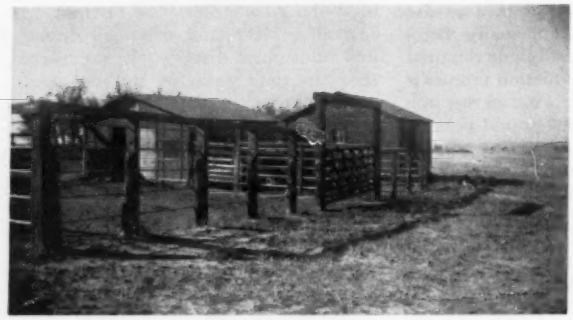
Atmosphere On The Moon?

Dr. Lyle E. Borst, Chairman of the Department of Physics, New York University, reported before the annual New York meeting of the American Physical Society in January, that British observations of the moon by radio-astronomy methods seem to indicate that the moon has an atmosphere of about 20- to 60-trillionths that of Earth's. A further assumption is that it consists of krypton and xenon, two heavy gases that may have been formed by the spontaneous fission of uranium 238 in the moon's surface. On the basis of these assumptions, Dr. Borst concludes that the moon contains only about 1 percent as much uranium as is found in the surface formations of Earth. Further studies, based on the radioactivity of the moon, lead Dr. Borst to the view that the moon required some 400 million years to evolve to its present form, and that it has remained virtually unchanged for at least the last 3 or 4 billion years.

BEHOLD! THE WHALE

The tanks shown in the picture at the left each hold 15,000 gallons and are 47 feet long, 10⅔ feet wide and 5¼ feet high. In the other picture, the same tanks are shown rolled up into a package less than 8 feet long and about 2½ feet in diameter. Made of nylon and coated with DuPont neoprene rubber, the portable tanks weigh about 1200 pounds each, complete with all built-in parts including flexible interior stabilizers that prevent the tank from rolling, even when set on slopes as great as 20 percent. The tanks can be filled or emptied at flow rates up to 2500 gpm, and resist sunlight, weather and oils. To date, they've been applied mostly in oil fields, handling crude oil as well as water. Roustabouts have dubbed them "whales." Although they can't compete in price with steel tanks for permanent installations, the whales can save a lot of money on temporary jobs. The costs, per 10 miles, of transporting a steel unit of equal capacity are said to be from $21 to $35, while moving a rubber one the same distance costs as little as $1.50 to $2.50. The Firestone Tire & Rubber Company makes the whales and has outlined some prospective applications for them, including their use on flat-bed trucks. So used, they would permit a vehicle to carry fluids to one location, have its tank rolled up on arrival and return with a different type of cargo.

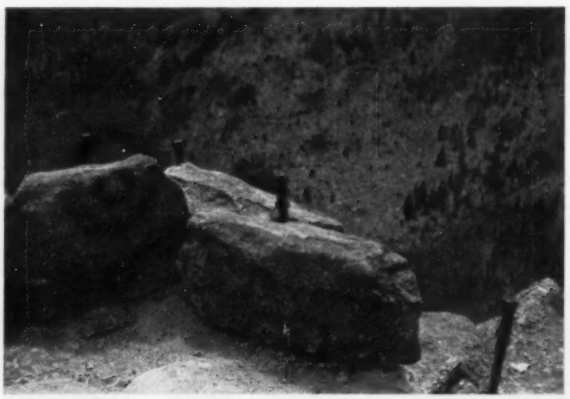
FENCES OF DRILL STEEL

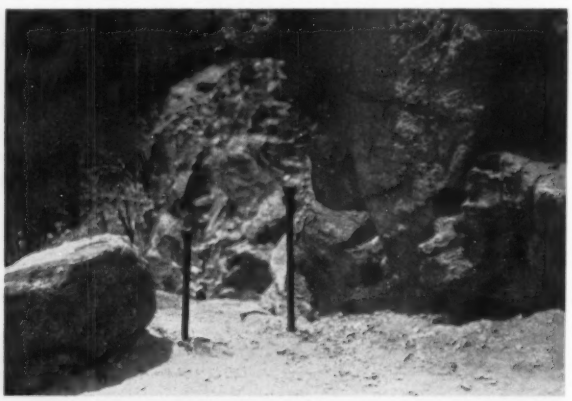


Most drill steel, when its days of usefulness are over, finds its way to scrap yards, eventually gravitating back to some steel mill or other, and there being turned into any number of new ferrous products. Some of it, of course, is left to rust by the wayside. Other sections sometimes wind up in their original form, but serving far different needs than the one for which they were designed, as illustrated in these four photographs.

These pictures show drill steel used in fences and guard rails. The illustrations below came to us in a roundabout way and supposedly were taken west of Denver, Colo., in a so-called Juniper Pass. We haven't been able to find such a pass on the map, although there is a Juniper Mountain, Little Juniper Mountain and Juniper Springs. Shown are old Leyner steels embedded in rock along a mountain highway at an observation point, evidently being used to reinforce the rock guard wall. Since these pictures are dated at about 1938, the guard rail, and even the highway itself, may have been rebuilt, or may no longer be in use, having given way to a modern thoroughfare.

The scenes above show a corral built by M. D. MacArthur on a ranch near Littleton, Colo. Made by stringing old steel between uprights, some portions of the corral utilize 1-inch, cold-rolled, hollow steel of 5-foot lengths. The remainder is made up of 10-foot lengths of 1¼-inch diameter steel of solid section that was known as Cruciform steel. The latter was reclaimed from long-abandoned mines in the Central City and Idaho Springs mining districts.

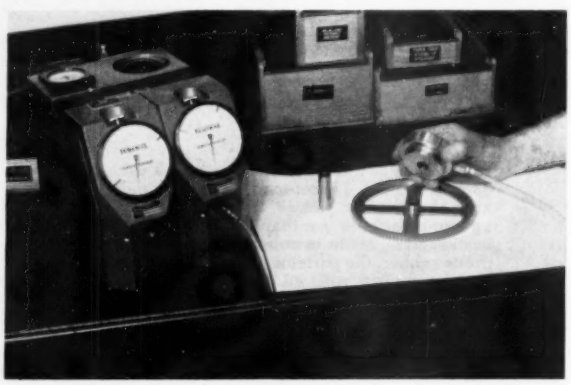




PRECISION PROBLEM SOLVED

THE shape and small size of the gear, illustrated at the right, allowed micrometers to measure only the outer portion of the hub. However, precision demanded that the entire hub be checked as well. These units are used on Man-Au-Trol brackets of Bullard vertical turret lathes. A specially designed air ring solved the problem. The device, which fits over the hub, has a pair of measuring air jets close to the bottom of the bore. By raising or lowering the ring, the operator can speedily measure the outside diameter to 0.0001 inch anywhere on the hub. The ring is connected to a Dimensionair, an air gauge manufactured by Federal Products Corporation. One master, pictured just to the left of the gear, is used for zeroing the gauge.

The air gauge shown here can also be used for measuring taper. A taper plug or ring contains two pairs of air jets, each pair tied into its own meter, but with a common air supply and pressure regulator. Again, only one master is used for zeroing the gauge, and the operator reads any variations in taper directly on the meter dial scales.



EDITORIAL

An Age of Study

EXCITING technological developments are revealed each day, it seems, and it is indeed true that we live in an age of research—both basic and applied. The recent ventures into the realm of controlled thermonuclear power, the launching of artificial satellites and other efforts to leave Earth for outer space, the conversion of sun power directly to electricity and the useful application of fission heat to thermoelectric power stations all point up the fact that future historians may label ours the age of research rather than of electronics, atoms or space.

This is a credulous generation as far as things of science are concerned. There is very little today of the derision and doubt which greeted the developers of electricity, airplanes, steam engines, cotton gins, automobiles and other inventions accompanying or following the Industrial Revolution. When greeted with news that some great scientific advance can be achieved or is in the making, we don't often ask "how *can* this be," only "when *will* it be." This is true even though most individuals don't understand just what makes these things tick: indeed, even the most learned of men working so successfully with new developments freely admit that sometimes they do not fully understand the phenomena.

IN THIS realm of advanced thinking, compressed air and gases play important roles. So does the fact of their absence—a vacuum. In the taming of fusion power, for example, the thermonuclear reaction is carried on in a plasma, which is defined by scientists as a gaseous mixture of positive ions and electrons. In the experiments leading up to the startling scientific advance jointly announced by the United States and Great Britain in January, a plasma of deuterium gas was brought to a temperature of as great as 6,000,000°C and held there long enough for it to be shown that some energy in the form of neutrons was being given off. To successfully tap the enormous reserves of power that might come from the fusion of elements, scientists tell us that deuterium gas must be heated to a temperature of 100,000,000°C and contained for much longer periods of time. The gas is confined within the walls of a "vessel" made up of magnetic lines of force, in itself quite an advance.

Although it has not yet been possible to make a device that will produce more power than it consumes, the outlook is so favorable that, in the words of Atomic Energy Commission Chairman Lewis L. Strauss, it justifies the "necessary expenditures of money, time and talent."

IT IS in the realm of space travel, of satellites and of moon rockets that compressed air and gases, at temperatures and pressures with which most of us are familiar, really come to the fore. No discussion of manned rockets or satellites—or even ones carrying animals—can be complete without some mention of air that can be breathed. Wherever man may go outside of the thin blanket that surrounds our globe, he must carry with him not only a supply of air, but the equipment to handle it, compress it, purify and store it. Among many ideas advanced for assuring a supply of breathing air on space ships is one that suggests that green plants in a hydroponic garden be used to remove carbon dioxide, as Nature does it.

The potential energy of compressed gas is also very much a part of the thinking of rocket experts. They point out that guidance of ships and missiles in space cannot depend on the flow of air over control surfaces. The well-known basic law of physics stating that for every action, there is an equal and opposite reaction, provides an answer, however, and compressed air seems to some to be the logical way to secure the desired effect. Thus a jet of air issuing from one side of a rocket would produce sufficient "kickback" to alter its course. Blasts released tangentially could start a space ship or satellite rotating, thus providing an artificial "gravity" by means of the principles of centrifugal force.

IN OUR colleges and universities, in industry and government establishments, learned men discuss earnestly the problems of interplanetary travel, of obtaining a virtually inexhaustable fuel supply from the oceans in the form of deuterium, of stopping many dread diseases and of wiping out hunger and want. In retrospect, considering the level of scientific knowledge only 20 years ago, such things seem too fantastic for dreams. Yet they are with us now.

The day will come when historians begin to look for key factors that have brought about the miracles with which we are regaled. True, there will be some names that stand out—Einstein, Fermi and their peers. But science today is too complex to point to a few and say that these are the ones to whom credit is due. We would cast a vote to industry at large and to the engineers and scientists engaged in basic and applied research therein. They are the ones who have brought about the vast number of smaller miracles that year by year have raised living standards, reduced manual labor while boosting productivity, and have pointed and paved the way for the bigger steps.

Magnetic Holders For Conveyor Line

CONVEYOR CYCLE

Carboloy mining tools are ready for dip painting and are being attached to a conveyor line that consists of a series of General Electric Alnico horseshoe magnets (left). Since the magnets are free to swing, the parts always hang down and apart from each other, even though the conveyor line turns and dips. Aluminum lacquer is kept stirred by mechanical agitation throughout the process (center). After dipping, the tools are passed through a jet of compressed air to blow the excess paint from them, and then are passed through an air circulating chamber before they are removed for shipment (right). The equipment is automatically cleaned with a hot, alkaline solution.

INGENUITY at General Electric Company's Metallurgical Products Department, Detroit, Mich., has solved a troublesome problem in production-line painting of Carboloy mining tools through the use of magnets. In setting up the routine, numerous materials handling problems were encountered. After inspection, the unpainted tools are attached by hand to an overhead conveyor line. As the line moves, it dips to permit the parts to enter a lacquer bath. After being painted in this manner, they are dried as they pass by a blast of compressed air and through a circulating air chamber. They are next removed by hand, at the end of the cycle, reinspected and packaged ready for shipment.

With several sizes and shapes of tools in production at all times and regular mixed shipments being required, no mechanical fixture for holding the tools on the conveyor line proved sufficiently simple and troublefree.

The answer to this holding problem came in the form of GE Alnico V magnets. More than 400 one-ounce horseshoe magnets were attached with wire loops to suspended conveyor channels, about 12 inches long. The magnets swivel and permit the attached tools to hang vertically, even though the line itself has to climb or dip during the cycle. They are hung with like poles next to each other so that they do not exert any mutual attraction which would move them out of normal position.

The tools are dipped into aluminum lacquer that is kept stirred by a mechanical agitator. As they emerge, a blast of compressed air hits the tools to knock off built-up paint at the nose and at the upper end of the tool near the magnet. The drying process is accelerated by circulating air around the tools. After removal of the parts, the conveyor line continues, and the magnets pass through a hot, alkaline cleaning solution to remove any paint, and from there, through a hot water rinse. In this manner, the equipment is maintained clean automatically.

"Now try!"

Handling Sawdust

SAWDUST, certainly not the most convenient of materials to transport, is handled efficiently by vacuum at Norton Company's plant in Santa Clara, Calif. The abrasives manufacturing firm packs the sawdust around grinding wheels to prevent breakage during shipment.

Two chutes from an overhead hopper dispense the sawdust to packing stations directly below: one forms a flexible spout at its lower end for handy filling of packing containers; the other terminates in a square box instead of a spout. A sliding door on the box is opened and closed to control the flow.

Because only small quantities of sawdust are needed, the material is obtained in 80-pound bags or drums. These are emptied by a suction hose that deposits the material in the overhead hopper. Vacuum is drawn by a blower installed near the top of the hopper. When not in use the free end of the hose is hung out of the way of shipping room personnel.

VACUUM USED

Sawdust is used by the Norton Company, a manufacturer of abrasives and other products, as a cushion for packing grinding wheels for shipment from the firm's Santa Clara, Calif., plant. Shown here is the shipping station where the wheels are packed. At the far left is a flexible hose used for lifting the sawdust by suction to an overhead hopper. A blower supplies the vacuum. The two chutes tapering down from the hopper dispense the sawdust to shipping cartons. One has a box at its lower end, and the other, a spout.

Air-Operated Press

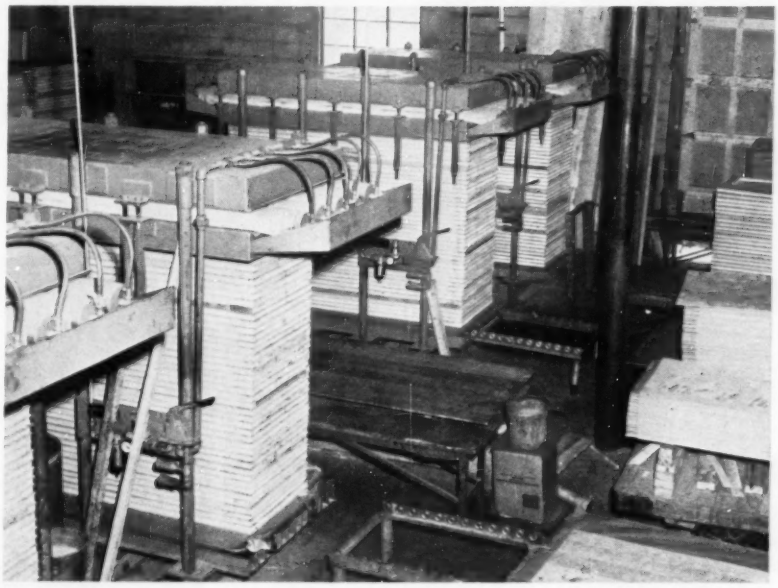
SUCCESSFUL use of several units of closely spaced, specially made, over-sized hose as an air pressure medium for a movable platen has resulted in the development of a commercial platen press by Black Brothers Company, Mendota, Ill. Such units are advantageous in fabrication of plastic-faced sink, counter and table tops; panel-on-frame work; hollow-core flush doors; and similar laminated products that require only moderate pressures where adhesives, such as vinyls and protein latex, are used.

A load of flat workpieces is placed on the press bed, extending upward to a point nearly contacting the under side of a top platen located immediately beneath the collapsed hose lengths. Although the hose used can expand approximately 4 inches, a normal 2-inch stroke provides plenty of clearance for loading the press and taking up any looseness in the press load. Pressure is delivered at about 60 psig over the platen area, and is supplied from shop air lines at 100-psig pressure. For press loads of smaller area, proportionately higher pressures can be obtained. For instance, 100-psig pressure can be applied to panels that occupy only 60 percent of the press platen area.

No special foundation is required for the press because the pressing load is transferred to over-sized strain rods in pure tension, thus eliminating pressure on the floor. As air is admitted to the hose, the top platen is driven downward, moving against the resistance of a gang of compression springs. When the pressing cycle has been completed, the springs automatically lift the upper platen, collapsing the hose.

The bed of the press contains two special spring-type roller loaders to facilitate loading and unloading. They consist of two tracks, supported by strong compression springs and carry closely spaced ball bearing rollers. The springs hold the tops of the rollers above the bottom platen, thus permitting loads to be readily moved into and out of the press.

When laminating pressure is applied by admitting compressed air to the hose, the roller-loader tracks recede, allowing the package to make full contact with the lower platen. When pressure is released the springs expand, causing the roller loaders to raise to normal position so the package may be easily withdrawn from the press.



PRESS ROOM

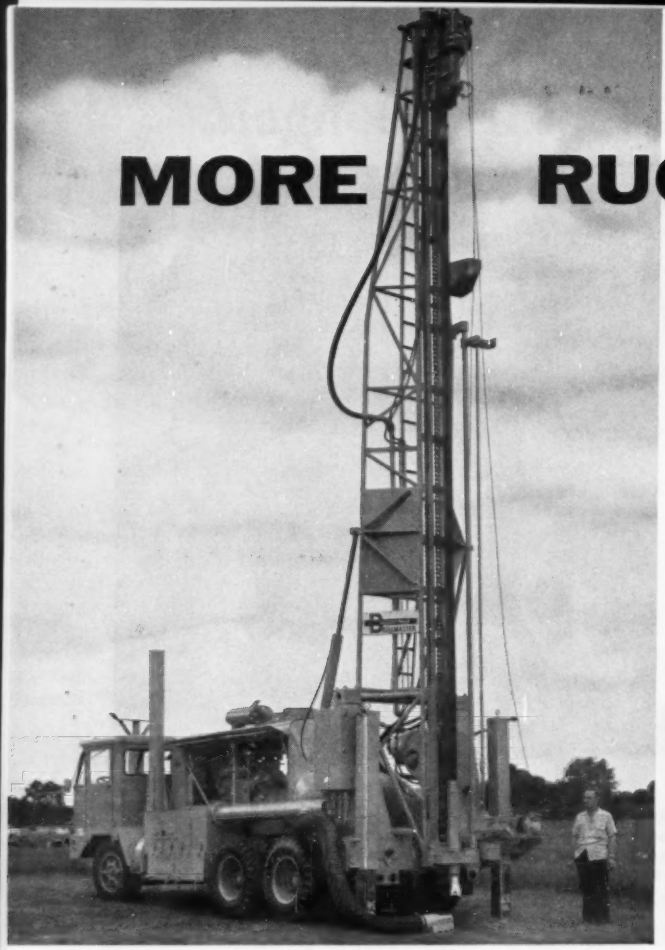
View of a press room at Leland Door Company, Suttons Bay, Mich., where four Black Brothers' air-hose presses are used in conjunction with two mechanical glue spreaders. The latter are at the right, but are not shown in the illustration above. Hand valves used for admitting air to the hose are seen on the rear sides of the presses. Each utilizes five lengths of air hose.

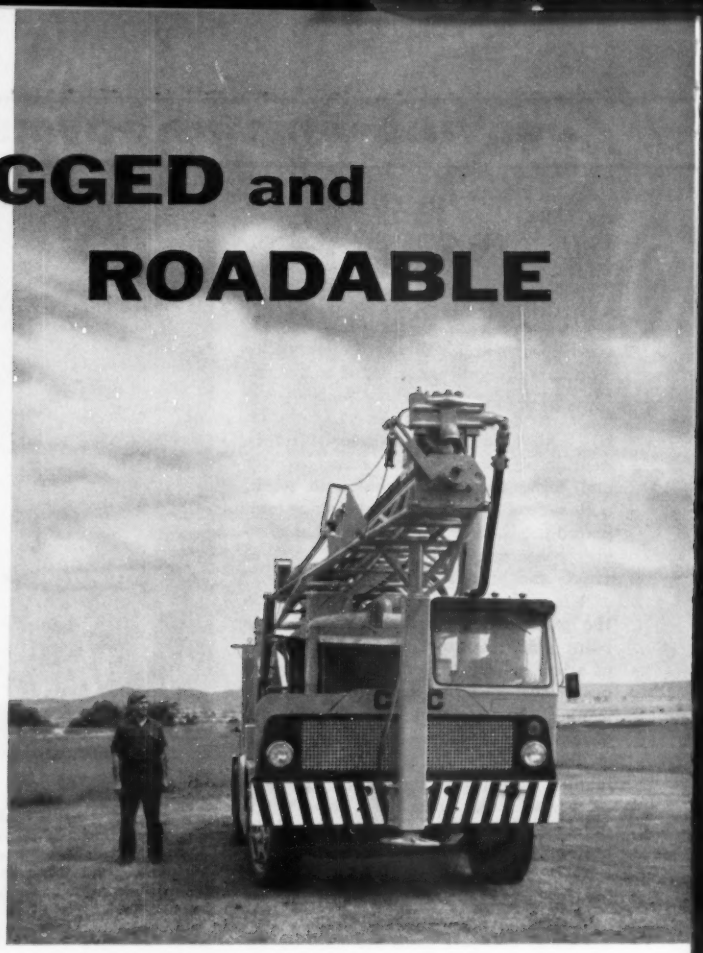
Air-Motor Jack

RECOVERY of power poles by a new method has been announced by The Joyce-Cridland Company. Its No. 1720-RGL air-motor jack, a 20-ton capacity, all-purpose model, was recently tested on 90-foot Class 2 poles. Dry earth's frictional hold was overcome, and the poles were pulled clear. In the past, some poles have had to be cut off at the ground level, reducing the possibility of their later reuse.

A truck-mounted "A" frame holds the pole erect, and a chain is stretched over a specially designed lift on the jack's cap and attached to the base of the pole. An operating pressure of 90 psig is required to operate the jack and is supplied by the utility company's compressor truck. The jack is powered by a heavy-duty Ingersoll-Rand vane-type air motor that provides an 18-inch lift. The device itself stands 28 inches high. weighs 240 pounds and can be rolled into position on semipneumatic tires. The jack will not lower until the motor is reversed. Automatic shut-offs at the top and bottom provide added safety.

"Here's that Phillips' report, Sir."





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On The Job...

The new truck-mounted Drillmaster gives you the proved *performance* and *versatility* that have made contract drillers acclaim it as the most productive blast-hole unit ever developed.

You can set up and be ready to drill in a matter of minutes. Tower is raised and leveled effortlessly by hydraulic power. With the I-R revolutionary *down-the-hole* drill you can drill from 70′ up to 350′ or more of 4¾″ to 6½″ blast holes per shift. And for soft non-abrasive over-burden and bed rock, use it as a heavy-duty *rotary drill.*

New "beefed-up" mounting means higher performance than ever before obtainable in a truck unit. Air power for all drilling functions is provided by a 600-cfm Gyro-Flo rotary compressor – known the world over for smooth-running performance, year-round dependability and exceptional freedom from maintenance and attention.

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This improved "TRUCM" mounting features a completely new mobile unit especially designed to I-R heavy-duty specifications by Crane Carrier Corp. – leading maker of specialized carriers. It can go anywhere at sustained highway speeds – meets legal requirements in all 48 States.

Here are the specifications, on the road ready to go:

Length	34′ 11″	Weight	34,000 lb.
Height	12′ 6″	Wheel Base	175″
Width	8′	Compressor Fuel Capacity	200 gal.

Ask your Ingersoll-Rand representative for complete information on this new truck-mounted Drillmaster – the most *rugged* and *roadable* unit you've ever seen.

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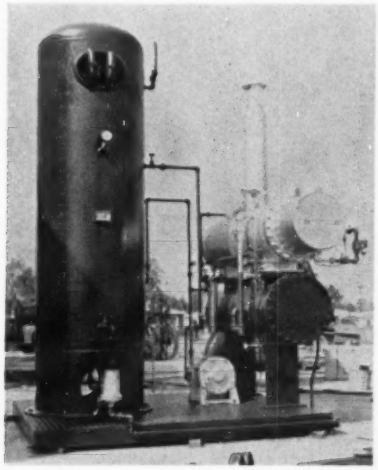
A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK

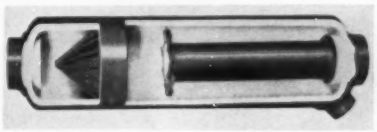
Industrial Notes

AIR dryers to eliminate condensation of water in piping systems are manufactured by T. Melsheimer Company. They



are designed and constructed for continuous, 24-hour, heavy-duty operation, in accordance with ASME and ASA codes. Said to be economical to install, they require no foundation. The completed units are shop-assembled on an integral structural steel base with all piping, controls and the like, self-contained. Each unit is self-powered by compressed air, and maintenance is limited to a daily check by the operator; the only moving part is the reciprocating pump. Normal pressure rating is 125 psig. The dewpoint is lowered 40°F below the temperature of the air entering the dryer. Units are available in standard sizes from 500 to 15,000 cfm, and can be furnished to meet special conditions of pressure, extreme dewpoint depression and special operating conditions. *Circle 2E on reply card*

A HELICOID tuyere, combined with a secondary vortex breaker, is increasing the separating efficiency and widening the flow-range of Centrifix Corporation's Type RA line purifiers. According to the manufacturer, use of these devices will result in a more nearly complete removal of water, oil, pipe scale, rust and sediment from compressed air, steam or vapor lines. Having no moving parts that require adjustment or maintenance, the units use centrifugal force to effect a positive separation. Reportedly, they guarantee the removal of 99 percent of all entrainment when properly installed. Built as standard units, for use in either horizontal or vertical positions, in sizes from 1- to 2-inch horizontal or vertical, and ¼- to ¾-inch vertical only, each has a forged steel body enclosing its stainless or monel tuyere. As vapor enters the purifier, the helicoid tuyere directs it into a whirling mass that forces all entrainment to the inside wall of the purifier body. At the same time, the design of the tuyere also controls the primary vortex action. The heavier particles flow down the inside wall of the purifier to the drain pocket where they are removed, while the clean, dry gas or vapor passes through the purifier outlet. The vortex breaker at the beginning of this outlet further prevents any reëntrainment due to secondary vortex action. It is built to give nonshock service for steam up to 400-psig pressure and 650°F and for compressed air or gas up to a pressure of 800 psig and a temperature of 100°F. The devices can be used in lines delivering air for spray painting, air drills, air brakes, molding and sand-



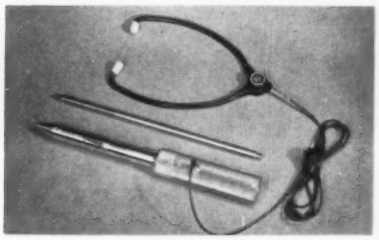
blast machines. In food products plants, they purify and dry steam used in cookers and packaging equipment, and in gas transmission lines, they remove oil, gasoline and moisture resulting in added protection for compressors and valves. They are reportedly also efficient as steam separators for small engines and turbines. *Circle 3E on reply card*

FISCHER & Porter Company's 2700 Series variable-area flowmeters feature packless, snap-in metering tubes. By using O-rings to seal the tube ends to the metal fittings, nuts, bolts, stuffing boxes, packing glands and all adjustments have been eliminated. Piping strains cannot be transmitted to the glass metering tube since the tube "floats" in the O-rings. Reportedly, flow rates of less than 1 cubic centimeter per minute to 40 gpm can be measured with only three meter sizes, whereas formerly eight models were required. Cleaning and range changing are simple, quick routines. Metering tubes can be snapped into position without the use of tools and without disconnecting or disassembling the meter itself.

Circle 4E on reply card

MAINTENANCE lapping can be accomplished by Model 10 Lapmaster, a product of Crane Packing Company. It is said that it will consistently reface mechanical seals, valve seats, compressor disks, fuel-injector parts and a variety of other pieces to a precision flatness of 0.0000116 inch and with micro-finishes of 2 to 3 rms. The device does not have to be stopped for redressing or truing the lap plate. Flatness of the lap plate is continuously maintained by the action of two conditioning rings. These are mounted on a 10-inch diameter lap plate and serve as work holders to accommo-

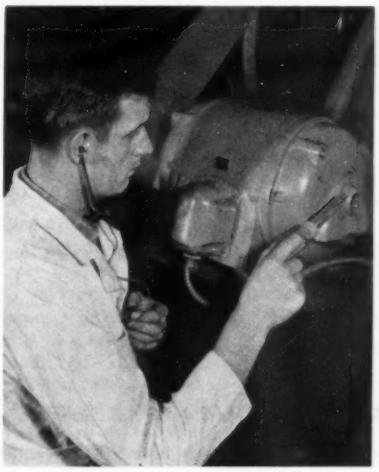
DETECTOSCOPE



DETECTOSCOPE is the name of an electronic probe with stethoscope-like ear pieces that is designed to locate and amplify internal sounds in bearings, motors, gear trains, pumps and turbines. All aluminum, the battery-powered unit makes use of transistors to reduce its size and weight. It incorporates a volume control and comes complete with an extension probe for getting at hard-to-reach spots. Manufactured by Valley Engineering Corporation, the device is said to be so sensitive that it can detect the flow of liquids through piping. It sells for $76.

Circle 1E on reply card

LISTENING IN
The picture, below, shows the Detectoscope checking for bearing noises on an electric motor. The other is a close-up view of the complete unit. The battery and all electronic components are contained in the body of the probe.



WIRE ROPE AT WORK

This hungry shovel, doggedly eating away at a steep embankment, thrives on a diet of dirt and rock. While working in the vicinity of York, Pennsylvania, it scooped out an average of 2,000 cu yd per day with its 3½-yd dipper. The job: preparing right-of-way for a new express route between York and Baltimore.

In places a deep cut was required, and the digging had to proceed at a steady pace, free of interruptions. The contractor, J. Robert Bazley Inc., guarded against wire rope failures by rigging the shovel with Bethlehem Purple Strand. This tough wire rope was furnished in the 6 x 25 construction for both hoist and boom lines. As always, its high strength and durability were important factors in keeping the shovel going full-tilt.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem rope for the following industries and numerous others:

CONSTRUCTION • EXCAVATING • MINING • QUARRYING • PETROLEUM • LOGGING • MANUFACTURING

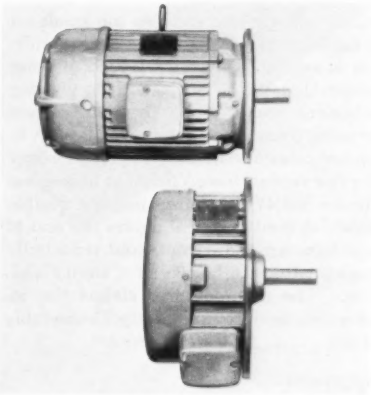
date parts as large as 3¾ inches in diameter. The rings may be removed and the roller guide bars repositioned to allow room for work with diameters as large as 7 inches. Parts may be of any shape, form or material, including all ferrous metals, magnesium, aluminum, brass, carbon, ceramics and plastics. The Model 10 Lapmaster operates from any standard 110-v, 60-cycle, single-phase outlet, and the complete machine measures 18x13x12 inches, including its steel weldment base, enclosed motor and lapping table. An enclosed drain pan is provided for drainage of spent compound. *Circle 5E on reply card*

AIR-LINE lubricators manufactured by Gits Bros. Mfg. Co., called Pneu-Liners, are devices that have been designed specifically for applications where few adjustments would be necessary once the initial setting was established. The fixtures incorporate Mist-a-Domes for easy viewing of the unit's operation at all times, thus permitting easy monitoring to avoid oil waste. The mist action is said to provide constant lubrication during the entire period of operation; all compressed air flowing through the device carries some oil along with it

for lubricating work. Large drops of oil reportedly can not pass through to cause contamination and slugging. Pneu-Liner, in the ½-inch size, lubricates an air flow of ¾ to 90 cfm.

Circle 6E on reply card

PANCAKE motors that are up to 60 percent shorter in axial length than standard units of the same rating have been announced by The Louis Allis Company. They are designed for use on machine tools, roof-ventilating fans and many other space-cramped applications. These are flange-type motors of conventional radial air-gap design and achieve their short length through formed end coils and a one piece housing-bearing bracket. For normal operating conditions, they are built in an open, drip-proof enclosure. However, where dirt, filings, corrosive chemicals, coolants or other contaminants are present, they are furnished in an enclosed construction. According to the manufacturer, the motors are available in ratings from 1 to 15 hp at 1800, 1200 and 900



rpm, and can be vertically or horizontally mounted.

Circle 7E on reply card

IDEAL Industries, Inc., is offering a machine-tool accessory for holding work between centers. Operation of the unit depends upon basic hydraulic and friction principles to grip one end face of work held between centers, without the use of chucks, clamps or dogs. Its driving action makes use of a circular chamber filled with hardened steel balls into which the back ends of a group of driving pins are pressed when the driving center is in operation. The balls act as a "fluid," distributing pressure equally to all the driving pins and locking them, as well as the centering pin, securely when the driving points have been driven into the work face. It is said that the Ideal Driving Center, as it is called, provides a rigid direct drive, without backlash, and that there are no problems with slack or chatter. The unit functions equally well with uniform work

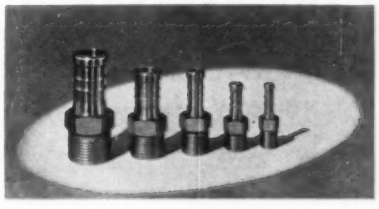
pieces, rough castings, forgings, or other uneven shapes or surfaces, thus permitting complete end-to-end machining without having to remove the work from the machine. They are available to fit Morse tapers Nos. 2 to 6, and work diameters ranging from 0.407 to 6.375 inches. *Circle 8E on reply card*

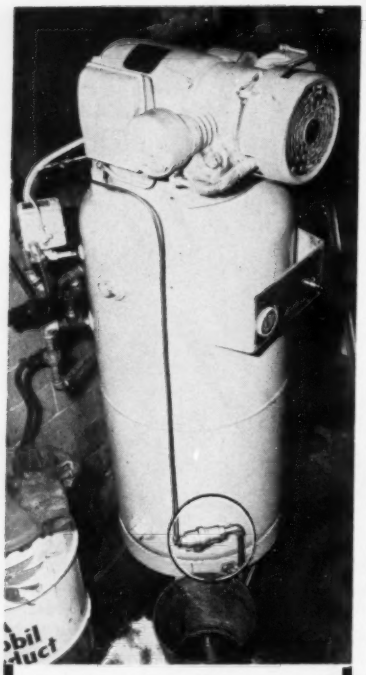
COMPRESSED gases are said to be cleansed of liquids and true vapors by a dual-functioning filter called Du Phase. This filter, manufactured by the Dollinger Corporation, uses both absorption and adsorption principles. First, air or gas travels through pads where absorption occurs. Then, it rises through a metal canister containing an adsorbent —activated carbon or silica gel. The canister life is reportedly about 150 hours.

A true vapor has molecules so small that they penetrate absorption filters. The adsorbent occludes or condenses the vapor, thereby collecting many such molecules into groups, thus increasing the particle size. These larger particles then adhere to microscopic pores in the adsorbent.

Circle 9E on reply card

HOSE nipples made of type 316 stainless steel are available in ¼x¼-, ⅜x⅜-, ½x½-, ¾x¾- and 1x1-inch sizes from Band-It Company. In addition to the anticorrosion characteristics of the steel,





A modern compressor equipped with George automatic drainage.

for AIR COMPRESSORS

HAND DRAINAGE is NOT ENOUGH

This "George" series 10000 automatic ejector, equipped with NYLON spindle, will keep this receiver free of water, oil, carbon and sludge.

Operates everytime the compressor stops and starts.

Can you afford unreliable hand drainage?

Specify George on your next compressor orders.

Literature on request.

GEORGE

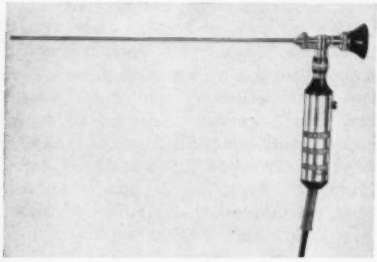
MANUFACTURING CO.
10-16 W. Harvey St.
Phila. 44, Pa.

Circle 13A on reply card

the nipple is said to be designed to provide maximum flow, greater holding qualities in the hose and extended hose life by minimizing abrasive action of the nipple end. Units are also offered in nineteen sizes of carbon steel, and eight of brass.

Circle 10E on reply card

INSPECTION of small holes in machinery and dies is possible with the Eder Instrument Company's hole inspection scope. A lens bulb shoots a



beam of light into cavities too small for a light probe. A ⅛-inch-diameter mirror is available for side viewing of holes larger than 0.125 inch, and side viewing adapters are available with diameters ranging from 0.123 to 0.500 inches. A 5-power telescope makes the image easier for the viewer to see. Another inspection device has 47 tiny lenses inside a flexible tube. A control wheel moves the end of the tube around corners and reportedly makes almost all areas of a cavity visible. The manufacturer claims the inspection devices save costly disassembly work. *Circle 11E on reply card*

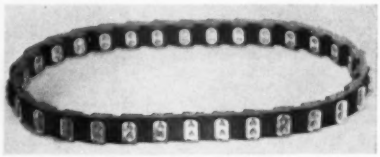
EXTRA dust storage capacity is a feature of the Dustkop Model 520-D dust collector announced by the Aget Manufacturing Company. This unit is designed for use in shops where the dust volume is unusually large. It is 10 inches higher than the standard Model 520 and has identical air handling characteristics and base dimensions, but the dust storage bin is said to be more than twice as large. The base is 18x23 inches and the height is 34 inches.

Circle 12E on reply card

A MANUAL shut-off valve for high-pressure gas systems and missile and rocket applications has been announced by Circle Seal Products Company. Primary features of the valve are said to be its reduced operating torque, deep finger dents in the handle, large flow passages and a long stem length. The valve, rated at 5000 psig, reportedly provides positive, leak-proof shut-off by means of a resilient O-ring that automatically withdraws from the fluid stream as soon as the valve begins to open. Throttling is then accomplished by a conical metal plug that varies the orifice flow. During throttling the O-ring is outside the fluid stream and caged to prevent possibility of washout. The valve is made from stainless bar-stock and can be used in both pneumatic and hydraulic service.

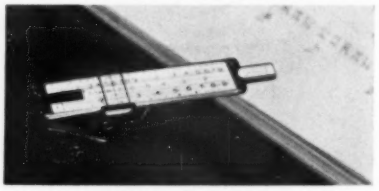
Circle 13E on reply card

VARIABLE-SPEED belts that are being marketed by Manheim Manufacturing & Belting Company are designated MVS. Each can be adjusted to any desired length, reportedly eliminates vibration and can be installed without dismantling machinery. Made of oil- and heat-resistant neoprene, the belt is designed in a series of links held securely by a patented fastener. It comes in a wide range of sizes to replace practically all types of belts used on variable speed drives in bakeries, dairies, printing, bottling, food, paper, machine tool, metal working, electronics and similar industries.



Circle 14E on reply card

INDICATOR lights for use in heavy-duty industrial applications are being manufactured by Dialight Corporation. These units reportedly are permanently oil-, water- and dust-tight because of specially designed bushings and lens caps made of 1-piece solid brass and fully gasketed. Each device features a built-in resistor for use with NE-51 neon glow lamps on voltages up to 250. The resistor is an integral part of the assembly, built-in within the base of the unit. Similar fixtures are also made without the resistor for use with low-voltage incandescent lamps with miniature bay-

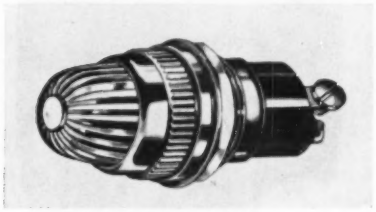


MINIRULE

Engineers and researchers can now buy what might be termed their "trade mark"—a slide rule—in a miniature size. Less than 2 inches overall, it is realistically detailed so that it appears to be fully operational. Mounted on a universal clamp, it may be used as a tie clasp or paper clip.

Circle 15E on reply card

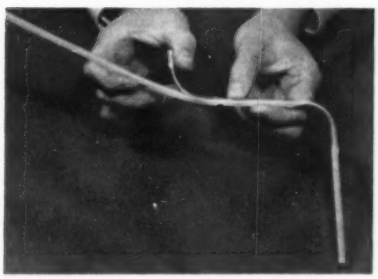
onet bases. The stovepipe lens, as illustrated below, is of the fluted type and provides omnidirectional visibility; how-



ever lights may also be specified as plain, unfrosted or frosted back. There is a choice of seven lens colors, and terminals may be either screw or soldering type. *Circle 16E on reply card*

A MECHANICAL loading arm that eliminates the need for an operator to lift fixtures manually has been added by Grav-i-Flo Corporation to its Spin-Finish machine. The device is pneumatically powered, with fingertip hydraulic control providing what is said to be quick, easy pick-up of fixtures for loading and unloading the machine. This cycle is governed by one button that operates the loading arm vertically. For horizontal motion, the operator merely extends or retracts the telescoping arm. At the end of the mechanical arm is a fork that fits under the collar of the fixture. This arrangement permits the operator to pick up parts and place them effortlessly into the Spin-Finish machine. *Circle 17E on reply card*

TUBE bending clips for holding a bend in plastic are available from The Polymer Corporation of Pennsylvania. They were developed for Nylaflow poly-



amide tubing. The attachment accessory is reportedly designed to hold a permanent 90-degree bend in ¼-inch OD tubing and can save installation time in such applications as instrument, hydraulic, lubrication, air or other fluid lines where 1-inch-radius bends are indicated. The clip is manually attached by a simple snap-on procedure, and is easily removed and placed at another location on the tubing.

Circle 18E on reply card

new shock-absorber

chipping hammers by Ingersoll-Rand

Ingersoll-Rand has done it again—introduced a "shock-absorber" chipping hammer. Here are a few of the advantages this new concept in hammer design gives you:

- Provides new operator comfort and efficiency
- Cushions the chisel in the cut
- Absorbs chisel vibration
- Substantially reduces noise
- Eliminates maintenance due to improper operation

These new Shock-Absorber Chipping Hammers are made in 5 sizes—each with four easily converted power ranges. This means you have 20 power combinations to meet exactly the cutting need of any type of job.

Call your nearby Ingersoll-Rand AIRengineer. He will be glad to show you this revolutionary new tool, and let you test it in your own shop, on your own work. Both you and your men will prefer it. Ingersoll-Rand, 11 Broadway, New York 4, N.Y.

8-750

Ingersoll-Rand

Tools plus AIRengineering increase output per man

Circle 14A on reply card

"AIR KING"

Quick-Acting

HOSE COUPLINGS

For All Hose Connections

These plain rugged couplings are your surest safeguard against loss of air at the hose connections. Universal locking heads, on sizes up to 1", snap together to form a secure lock that is leakproof under pressure; in fact, pressure must be released before coupling can be disconnected. Ideal for rough outdoor work as well as indoor shop and plant service. Malleable iron, cadmium plated, and bronze. Hose Ends, Male and Female I.P.T. Ends. Size range, ¼" to 1". Also available in 4-lug type, not universal, in 1¼" to 2" sizes.

"BOSS"

Self-Honing

AIR VALVES

For the Entire System

The most efficient and economical valves for all valve stations on the system—automatically, permanently leakproof—no packing to wear out and replace—straight-line, full-flow opening through body and plug. Self-adjusting bronze plug automatically hones itself against harder steel or malleable iron valve body, maintaining a perfect leakproof seat. Proper spring tension assures constant sealing adjustment. Strong, durable construction, with handle attached to plug within the valve body. Male or female thread both ends, in sizes ¾" to 1½".

Stocked by Manufacturers and Distributors of Industrial Rubber Products

DIXON

Valve & Coupling Co.

GENERAL OFFICES & FACTORY—PHILADELPHIA 22, PA.

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Circle 15A on reply card

BRIEFS

An electrically conductive paper that is built up of metal fibers in much the same manner as ordinary paper has been developed. It resists extreme temperatures, has magnetic properties and conducts heat.

Projects involving $3.9 billion are underway on the Federal-Aid Highway Program, and another $800 million is earmarked for advertised contracts.

Niobium, or columbium as it is sometimes called, can be refined to usable purity according to E. I. du Pont de Nemours & Company. Since it can be made in alloy form, it may answer metallurgists' problems of finding high-strength-at-high-temperature metals.

The Atomic Energy Commission has announced that domestic uranium-concentrate production has reached an annual rate of 10,000 tons of uranium oxide.

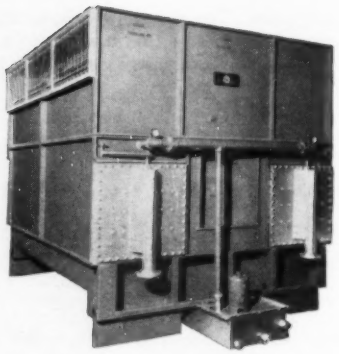
The U. S. Navy has announced a mechanical compression method for changing salt water into fresh water, that uses ice made from brine. Freshwater ice crystals are separated from brine ice by compression methods after a single freezing stage.

Chairman Herbert C. Bonner of the House Merchant Marine Committee has appointed a 6-man staff to advise his group on the question of enlarging the present Panama Canal, or opening a second canal in Central America.

Time-of-Flight Mass Spectrometer is an instrument that has been developed to give instantaneous chemical analyses. It is reportedly speedy enough—0.0001 second—to analyze individual explosions of rocket, jet and internal-combustion fuels during engine operation.

The Departments of Labor and Commerce have jointly announced that new construction outlays for 1958 are expected to surpass last year's record spending by 5 percent. Nearly $50 billion of work is forecast.

Ross Operating Valve Company predicts an increase of 10 percent in the number of valves manufactured for compressed air control purposes in 1958. The firm estimates 1957 production at 700,000 units, not counting midget varieties.



Is your plant CRITICALLY SHORT of WATER?

You will make major water savings, reduce your costs, solve your problems of water supply or disposal and get HIGH OPERATIONAL EFFICIENCY with Niagara "Aero" Evaporative Heat Exchangers, After Coolers or Condensers for these important plant services or processes:

- AFTER COOLING and air drying for large air and gas compressors and AIR LIQUEFACTION
- COOLING ENGINES, COMPRESSORS, HYDRAULIC PRESSES
- COOLING QUENCH BATHS, FURNACES, INERT ATMOSPHERES
- COOLING ROLLS, WELDERS, DRAWING OR EXTRUSION DIES
- PRODUCT AND PROCESS COOLING CHEMICALS OR INTERMEDIATES
- COOLING LIQUIDS OR GASES IN CLOSED SYSTEMS
- VAPOR CONDENSING UNDER VACUUM
- ELECTRONIC PROCESS COOLING

High operational efficiency means: precise temperature for improved product and process quality control, heat removal at rate of input, simple operating conditions, real economy in upkeep, sustained full capacity.

Also it means cooling in a closed system with your product kept free from contamination or, when condensing, getting a pure condensate holding high quality in your product or material.

Niagara machines do the work of a cooling tower plus shell-and-tube coolers with a single machine that saves piping, water handling disposal and treatment expense and 95% of water consumed by contact cooling methods.

Write for Bulletin 129, 130, 132, 136R.

NIAGARA BLOWER COMPANY

Over 35 years of Service in Industrial Air Engineering

Dept. CA-3, 405 Lexington Avenue

NEW YORK 17, N. Y.

District Engineers in Principal Cities of U. S. and Canada

Circle 16A on reply card

Industrial Books, Films and Literature

MATERIALS handling is the subject of a volume prepared under the sponsorship of the American Material Handling Society and the Materials Handling Division of The American Society of Mechanical Engineers. It is edited by Harold A. Bolz, Associate Dean of the College of Engineering at Ohio University. Said to be one of the most complete reference books available on the subject, its preparation required more than 5 years. The 1750-page volume contains virtually all of the progress made to date in materials handling. Copiously illustrated with photographs, charts, tables and diagrams, it is divided into 47 sections, each with its own table of contents and edited by one or more of 84 specialists and contributing editors, covering methods of analyzing handling problems; principles, procedures and techniques for effective operation and control; systems design and installation; integration of materials handling activities with the manufacturing processes; and the design, selection and classification of materials handling equipment. All types of conveyors, winches, cranes, powered and hand trucks, marine, air and railroad carriers and terminals, and warehouse and yard handling equipment are included. There is also a section on using predetermined data and setting up a job-related training program, including organization instruction and sample tests. Copies of *The Materials Handling Handbook* may be purchased from the publisher, Ronald Press, 15 East Twenty-Sixth Street, New York, N. Y. Cost, $20.*

*Members of ASME and AMHS may obtain copies of the book at a 20-percent discount.

WHETHER involved in sanding, grinding or polishing operations in a factory, or a do-it-yourself project in the home workshop, there are precautions that should be observed in the use of coated abrasives. The dangers involved and safety steps that ought to be taken are detailed in Data Sheet D-452, *Coated Abrasives*, a publication of the National Safety Council.

Circle 19E on reply card

CATERPILLAR Tractor Co., has produced a 5-minute, 16-mm sound-and-color film, entitled *The PRECO Automatic Blade Control*, to show how finish grading can be done faster and easier and with greater economy with a versatile attachment for No. 12 and No. 112 motor graders. Photographed under actual job conditions, the film shows the advantages of the control. The motor grader operator begins the demonstration by setting the calibrated dial for

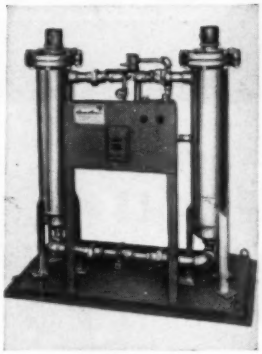
NOW! KAHN offers the NEW!

KAHN HEATLESS DESICCANT AIR DRYERS

Reactivated without heat

Check these advantages:

* **Costs reduced on installation and maintenance.**
* **Steam and electric heaters eliminated . . . reducing utility costs.**
* **Constant outlet gas temperatures.**
* **Explosion proofing eliminated.**



It's
KAHN DRYERS
all the way . . .

Kahn has a complete line of electric or steam regeneration dryers - automatic, semi-automatic or manual operative. Operating pressures up to 5,000 psi.

Write for complete information.

Kahn and Company, Inc. 541 WINDSOR ST., Dept. B HARTFORD 1, CONN.

Circle 17A on reply card

Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC.
209 East Park Drive, Buffalo 17, New York

The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

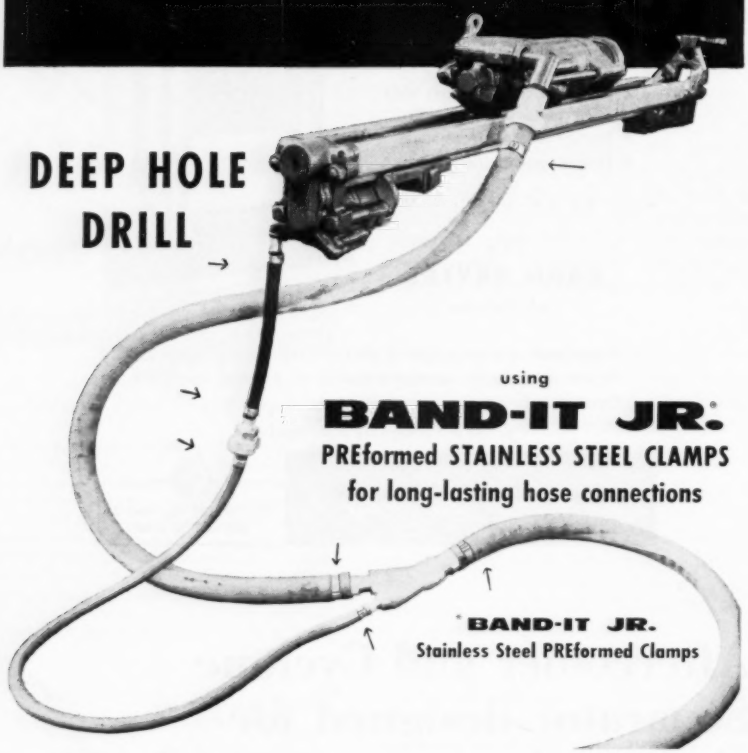
Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm where it is necessary to cool within 2°F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is ½ psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.

Circle 18A on reply card

"Moves mountains" with the help of

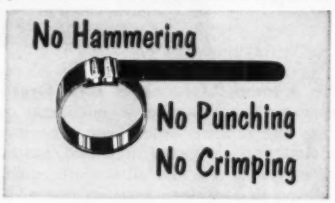
BAND-IT® CLAMPS



This deep hole drill meets extreme abuse as it drills through loose strata and solid rock alike. Tension, flex, surge, high line pressures and great vibration require ultimate in hose clamp. The manufacturer meets these requirements by using BAND-IT JR.* clamps on hose of these rugged machines.

IF YOURS IS A TOUGH CLAMPING PROBLEM, SOLVE IT WITH BAND-IT CLAMPS

The BAND-IT tool—BAND-IT band and BAND-IT buckles are all that is required to form clamps of any diameter from continuous roll of stainless steel BAND-IT band, without waste and in only a few seconds.



BAND-IT Jr., stainless steel preformed clamps in 18 sizes for ¼" to 6" diameters are applied with ease in seconds, using only the BAND-IT tool and adapter. For production clamping we offer the BAND-IT air tools.

SEND FOR NEW, FREE CATALOG

Over 1500 authorized BAND-IT DISTRIBUTORS *throughout the United States and in 59 other countries of the world*

BAND-IT CO.

Incorporated 1937

4765 DAHLIA • DENVER 16, COLORADO • U.S.A.

BAND-IT CLAMPS GO ROUND THE WORLD

Circle 19A on reply card

desired moldboard adjustment. As soon as the grader begins a pass, the control takes over and maintains the preselected slope across the grade. The film also shows how the control can double production; only one or two passes are usually required to shape a finish grade. Showing of the picture can be arranged by writing to the Advertising Division, Caterpillar Tractor Co., Peoria, Ill.

PRACTICAL solutions to the problems of industrial waste and water conservation are detailed in *Pure and Simple*, a motion picture released by Link-Belt Company. It highlights ways in which industry can conserve its natural water resources by combating pollution, salvaging valuable by-products, recirculating water and treating sewage wastes. The film illustrates how problems were solved in installations at chemical plants, oil refineries, food processing plants, steel mills and pulp and paper mills. Specialized equipment is portrayed in action, and details of how various systems work are dramatized by animation. This 19-minute reel is available on letterhead request for showing to those companies or sanitary engineering organizations concerned with industrial waste problems, from Public Relations Department, Link-Belt Company, Prudential Plaza, Chicago 1, Ill.

AIR STARTING motors for starting diesel, gasoline and natural-gas engines is the subject of Form 5094D published by Ingersoll-Rand Company. Detailed specifications and mounting dimensions of 34 models in the company's line are contained in it. Approximately 500 popular engines made by 25 engine manufacturers are listed with the proper air starting motor shown for each engine. In addition, easy to follow instructions are included for selecting the correct unit for unlisted engines.

Circle 20E on reply card

POWER transmission belting made of polymer and chrome-tanned leather is the subject of a catalogue that has been issued by Extremultus, Inc. Sections on significant applications, a description of the belt, selection of the proper belt type, tensioning and maintenance and bearing load reduction are included.

Circle 21E on reply card

LABORATORY research and field study of the nature of corrosive attack on copper and copper alloys has been conducted for a period of 31 years by The American Brass Company. The findings are incorporated in "Theory of Corrosion and Types of Corrosive Attack," the first part of *Corrosion Resistance of Copper and Copper Alloys*. Included in this revised edition (the first edition was published in 1953) is a tabulation indicating the relative cor-

rosion resistance of the principal types of these metals when in contact with 186 different corroding agents. The first edition has proved its value as both an academic and practical reference, and the revised volume, Publication B-36R, is available to interested readers free of charge. *Circle 22E on reply card*

CHEMICAL milling is the subject of a 10-page brochure made available by United States Chemical Milling Corporation and is said to be the most complete and current discussion of the subject. Such topics as "What is Chemical Milling," "What Are Its Advantages," "Application Check List," "Metals That Can Be Chemically Milled," "How Chemical Milling Is Done," and the like are described with pictures and illustrations.

Circle 23E on reply card

ENGINEERING data about differential pressure-type flow meters is contained in a recent publication of The Bristol Company. The 22-page illustrated brochure (F1607) gives basic information and theory on the selection, sizing and installation of the various primary devices. After an introductory section outlining the theory of head-type flow-rate meters, the basic units, their uses and characteristics are described. Approved installation practices for gases, liquids and steam are then explained. This is followed by pages that list equations for calculating throat diameters and flow rates and finding manometer ranges. A series of tables of appropriate data for flow calculations concludes the booklet. *Circle 24E on reply card*

PERFORMANCE characteristics and model specifications of Skidmore-Wilhelm Manufacturing Company's torque wrench calibrator are detailed in Bulletin No. 210. The device is widely used in aircraft, appliance, automotive and assembly industries for setting and checking all types of torque wrenches in torques ranging from 0-200 inch-ounces to 0-2000 foot-pounds.

Circle 25E on reply card

GENERAL construction features of Marathon Electric Manufacturing Corporation's line of ½- to 200-hp d-c motors and ¾- to 200-kw generators are outlined in *Direct Current Motors and Generators*. Illustrations of applications in various industries are also included.

Circle 26E on reply card

DESCRIPTIONS of various worm gear reducer designs with horsepowers ranging from less than 0.1 to 121 are given in a Hewitt-Robins, Inc., 40-page booklet. Numerous drawings and specification tables show designs and ratings for the many standard units available.

Circle 27E on reply card

JAEGER *Speeds the Work, Cuts the Cost*

. . . with CONTINENTAL RED SEAL POWER

Completely hydraulic operation on Jaeger's newest Model JX Finishing Machine (shown above following Jaeger screw concrete spreader, and at right from another angle) gets the job done faster, and with less manpower. Model F-226 Continental engine powers gear-type hydraulic pumps, enabling the operator to extend or retract width as much as six feet; drive forward or reverse; oscillate, lift and lower his finishing screeds; swing rear screed when diagonal setting is needed; operate tamper attachment, or raise and lower entire machine on its transportation wheels—all at the touch of a lever. Slab width on this job flared from 12 feet to 18 feet approaching the intersection. But the self-widening feature of the Model JX permitted continuous width adjustment, without stopping and without labor. Take a tip from the performance record of these and other Jaeger products:

CONTINENTAL MOTORS — Powerful as the Nation — AMERICA'S STANDARD

STANDARDIZE ON EQUIPMENT WITH DEPENDABLE RED SEAL POWER

SERVICE FACILITIES AND RED SEAL PARTS AVAILABLE EVERYWHERE

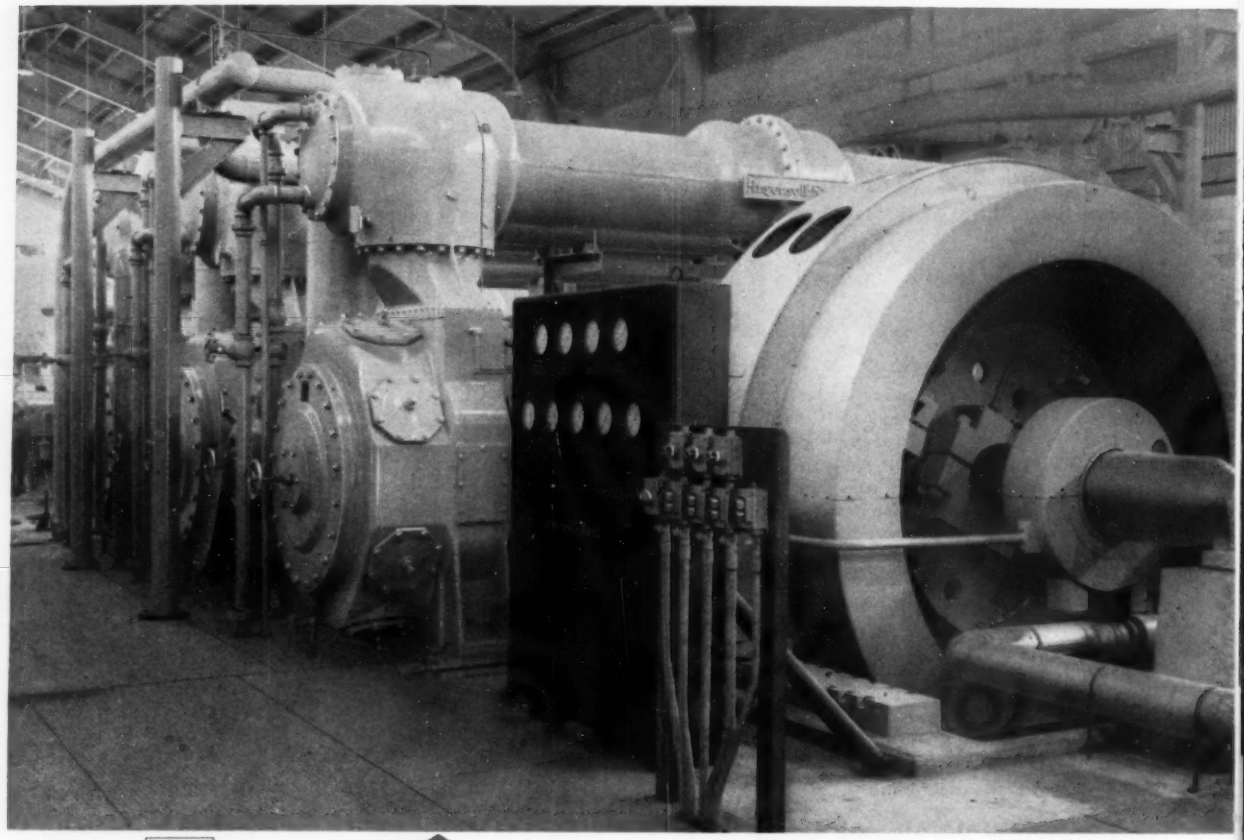
Continental Motors Corporation

MUSKEGON • MICHIGAN

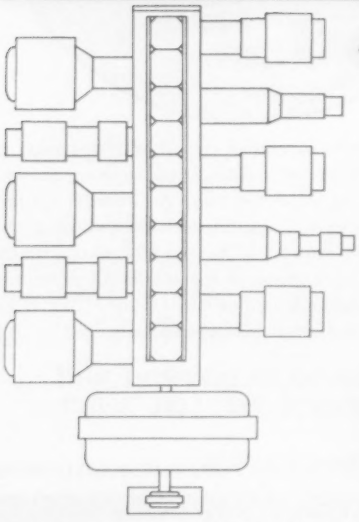
6 EAST 45TH ST., NEW YORK 17, NEW YORK • 3817 S. SANTA FE AVE., LOS ANGELES 58, CALIF.
6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 1252 OAKLEIGH DR., EAST POINT (ATLANTA) GA.

Circle 20A on reply card

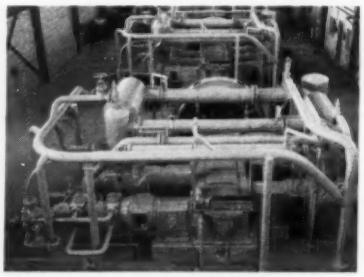
NATION'S LARGEST MOTOR-DRIVEN



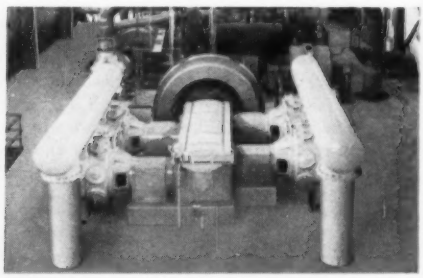
This is one of two ten-cylinder Ingersoll-Rand 6000-hp HHE compressors—the largest motor-driven reciprocating compressors in operation—on ammonia synthesis at the Geneva Works of Columbia-Geneva Steel, Geneva, Utah. Each unit simultaneously compresses coke-oven gas in two stages to 200 psi, and synthesis gas in three stages to 5300 psi. They are installed in the nation's first major steel-mill coke-oven-gas ammonia plant, engineered and constructed by Blaw Knox.



I-R design permits cylinder arrangement for best gas flow; three large cylinders handle coke oven gas in first stage, three in second stage. Others compress synthesis gas in three stages.



Above are two 2000-hp HHE's on air separation service. Each compresses oil-free air to 80 psi, and nitrogen in four stages to 2800 psi. The air cylinders are among the largest non-lubricated cylinders ever built.



This 1750-hp Ingersoll-Rand HHE compressor at the Geneva Works handles fuel gas (coke-oven gas after removal of hydrogen and carbon dioxide) for use in the steel mill. All of these HHE's are installed in the same building.

RECIPROCATING COMPRESSORS

Two 6000-hp Ingersoll-Rand units now in operation at Columbia-Geneva Steel's* NEW NITROGEN PLANT

*Division of U.S. Steel

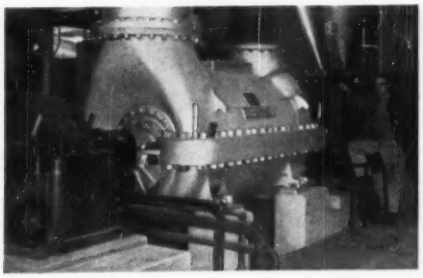
America's largest electric-driven reciprocating compressors are now at work in America's first steel-mill synthetic ammonia plant. Two ten-cylinder, 6000-hp Ingersoll-Rand HHE compressors—the first units of such size ever put into operation—are at the Geneva Works of U.S. Steel's Columbia-Geneva Steel Division in Geneva, Utah. The plant was engineered and constructed by Blaw Knox Company, and employs almost 20,000 hp of Ingersoll-Rand compressors, both reciprocating and centrifugal.

Big process jobs like this one require heavy-duty compressors that are *engineered* to the job. Compressors of this magnitude are not "off-the-shelf" items. At Ingersoll-Rand, each HHE compressor is carefully engineered from the ground up to fit the needs of its particular job.

First of all, the proper compressor cylinders are designed. They have to be of the right size, type and materials to suit the volumes, pressures and gases involved. No one can match the wide range of compressor cylinders built by Ingersoll-Rand, and the correct valving is assured by I-R's own valve design and manufacturing departments.

The cylinders must be arranged on the frame in the best sequence, and at the same time the crankshaft is *specially* designed for best running balance, smoothest torque and smoothest gas flow. These Ingersoll-Rand methods of *individual project analysis* have been proven in hundreds of process installations.

The world's most comprehensive compressor experience, in process *and* all other compressor applications, is offered by Ingersoll-Rand. Contact your I-R representative or write now for more information on HHE and other compressors for process services.



This 2800-hp I-R centrifugal compressor handles air for ammonia oxidation. The hot nitrogen from this reaction goes through an I-R expander—a power recovery turbine—which helps to drive the compressor itself.

Ingersoll-Rand

1-722

11 Broadway, New York 4, N.Y.

COMPRESSORS
VACUUM EQUIPMENT
ROCK DRILLS
GAS & DIESEL ENGINES

CONDENSERS
AIR & ELECTRIC TOOLS
PUMPS
TURBO-BLOWERS

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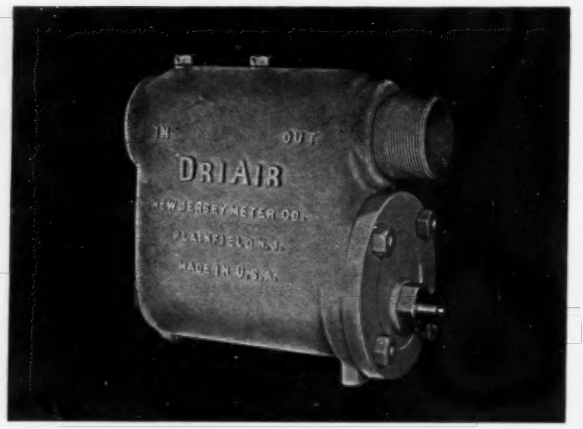
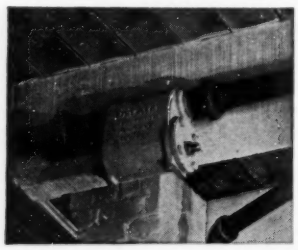
DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY DRIAIR

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

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LOW COST ***Preventive Maintenance***

For Pipe, Pipe Joints, Fittings, Couplings, Tanks, etc.

Use TAPECOAT®

...the Quality Coal Tar Coating in Handy Tape Form

To combat corrosion on underground pipe lines, you need the best possible protection at lowest possible cost. Since 1941, TAPECOAT has proved its superiority in resisting moisture, acids, alkalis, chemical fumes, electrolysis, soil stress, salt water and other severe corrosive and abrasive conditions. TAPECOAT is self-bonding, easy to apply spirally with the use of a torch. Requires no skilled help. Cuts maintenance and replacement costs. Comes in rolls of 2", 3", 4", 6", 18" and 24" widths.

Write for brochure and prices

The* TAPECOAT *Company 1571 Lyons Street Evanston, Illinois

Sales and Service Offices in Principal Cities

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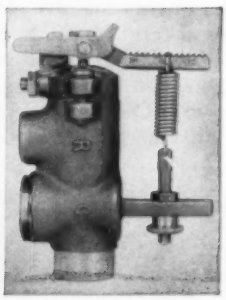
24 HOUR SERVICE

Factory Rebuilt UNLOADER VALVES

any age

any make

any condition



One day is all it takes to change old, worn-out unloader valves into factory rebuilts with new valve guarantee. Conrader exchanges all makes. Cost 1/3 less than new valves.

HOW'S YOUR STOCK OF SPARE VALVES?

R. CONRADER CO. INC.

BOX 924 • ERIE, PA.

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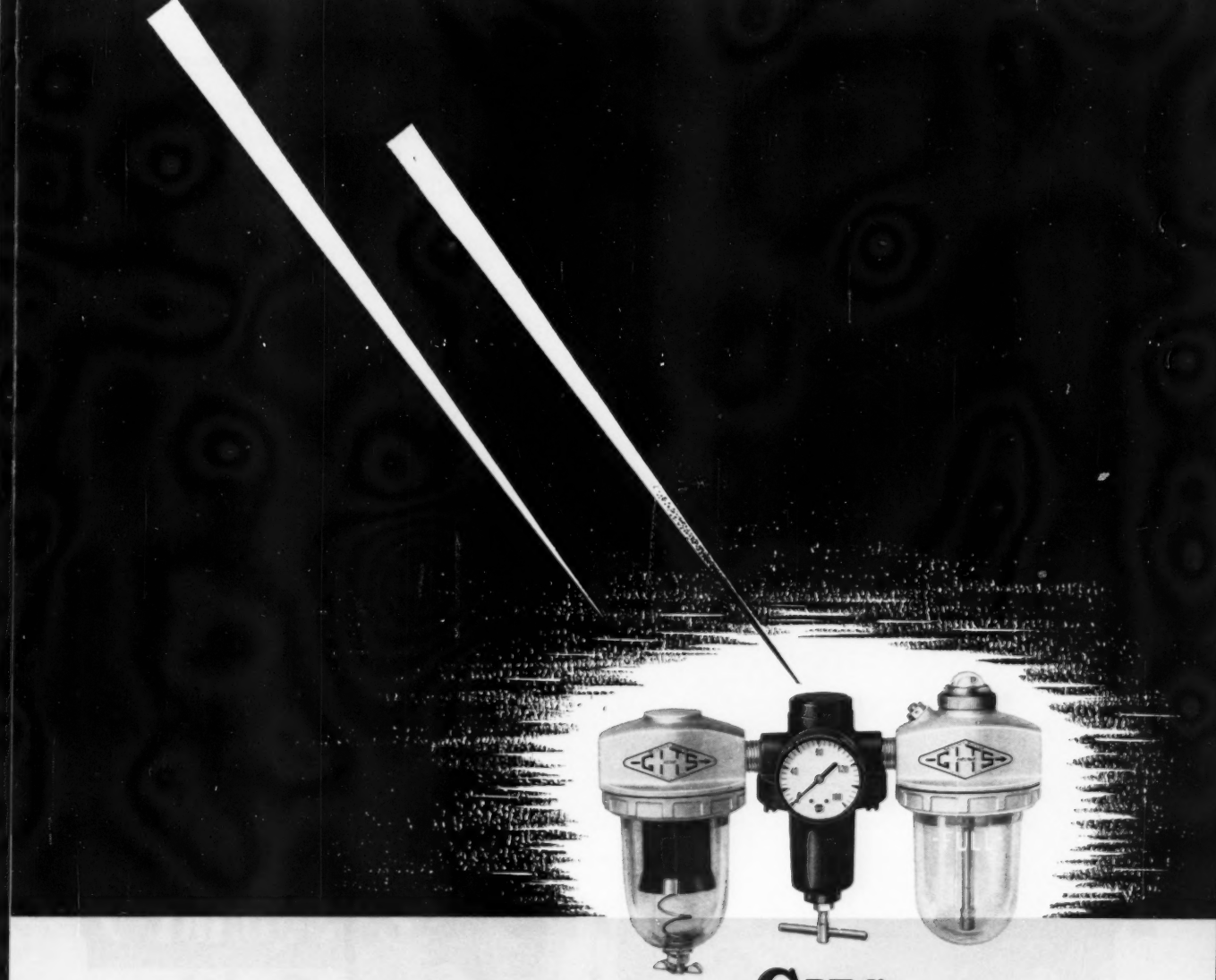

EXCLUSIVE

GITS MATCHED-SET AIR LINE LUBRICATION

To meet modern industry's growing demand for better air line lubrication, this complete "matched-set" line of Air Line Lubricators, Filters and Regulators offers an exclusive combination of important advantages, including:

REDUCED INVENTORY. Only 1 size handles any air line in the plant up to ¾" pipe size.

INSTANT MONITORING by Gits Mist-a-Dome.

MINIMUM PRESSURE DROP, regardless of volume of air: a result of Gits By-Pass Valve.

FLEXIBILITY. Can lubricate from ¾ to 90 cubic feet of air per minute.

See us at the Design Engineering Show Chicago Amphitheater, Booth 838

Get full details. Send for this **NEW FREE CATALOG**

GITS BROS. MFG. CO. *Pneumatics Division*
1852 South Kilbourn Avenue, Chicago 23, Illinois

MAYFIELD, Wash.—Workmen, held by safety ropes, drill away on a cloudy stone cliff high above roiling Cowlitz River to prepare abutment for Tacoma City Light's $37,000,000 Mayfield Dam being built to bring needed electrical energy to the northwest Washington area.

NO MATTER WHERE YOU GO—
If You See Hose, You'll See
PUNCH-LOK HOSE CLAMPS

Write for Descriptive Literature or
See Your Nearby PUNCH-LOK Distributor

"The Sign of a GOOD Hose Clamp"

PUNCH-LOK Company

6437 **Dept. H, 321 North Justine Street, Chicago 7, Illinois**

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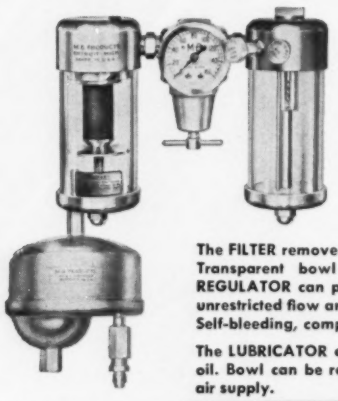
GREATER PROTECTION to your AIR LINE!

M-B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M·B PRODUCTS
46 VICTOR AVE., Div. 14
DETROIT 3, MICHIGAN

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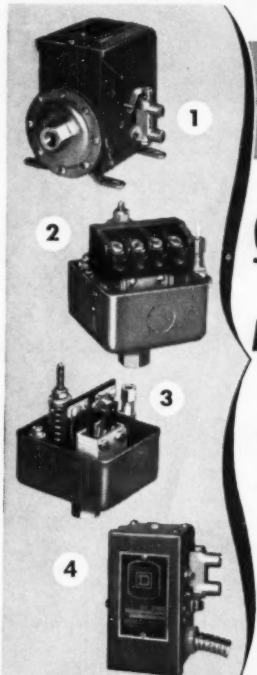


SQUARE D

FOR A
Complete Line
OF H.P. RATED
AIR COMPRESSOR SWITCHES

1. Heavy Duty
2. Standard Duty
3. Gas Engine Cut-Out
4. Magnetic Unloader

full range of electrical and pressure ratings

Write for Bulletin 550, Square D Company, 4041 North Richards St., Milwaukee 12, Wis.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

Circle 28A on reply card

Circle 29A on reply card

This Bucyrus-Erie 150-B is loading iron ore into end-dump trucks in a pit on the Mesabi Range.

CUT THE COSTS YOU CAN CONTROL
with Bucyrus-Erie Electric Shovels

The big capacity, rugged strength and long-life service built into Bucyurs-Erie electric shovels can help hold down digging and loading costs in your pit.

Years of service in every type of mine have proved the outstanding design features of these machines. Their sturdy front-end construction — with exclusive two-section boom, tubular dipper stick and twin dual hoist — provides plenty of strength, reduces deadweight, enables these shovels to handle big yardages economically. Bucyrus-Erie-improved Ward Leonard electric control provides fast acceleration and deceleration, extra torque and responsive power to speed work cycles. Strength and durability throughout assures efficient performance for profitable operations over a long period.

Let us give you complete information on these and other features of Bucyrus-Erie electric shovels and show you how they can help you control costs in your pit.

147L57C

A Familiar Sign... BUCYRUS ERIE ***..at Scenes of Progress***

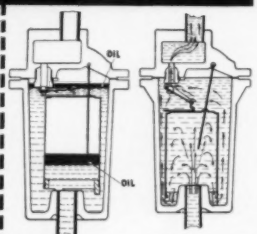
BUCYRUS-ERIE COMPANY • SOUTH MILWAUKEE, WISCONSIN

OIL WON'T STOP UP THIS AIR TRAP

Oil from heavy-duty compressors clogs ordinary ball-float traps—but not an Armstrong inverted bucket trap. The diagram at right shows how it handles even heavy oil.

(Warning—even an Armstrong will not handle oil-water emulsions described as "warm peanut butter".)

- **Handles Dirt**—No dead spots for dirt to collect. Dirt stays in suspension, won't settle on valve or seat—they're at top of trap.
- **Trouble-Free Construction**—Stainless steel working parts; heat-treated chrome steel valve and seat, lapped to a precision fit.
- **Flexible Installation** Installs above or below unit being drained, because of air bleed. Slight air loss (7-10 cu. ft./hr.) costs only about a penny a day, figuring air at 6¢ per 1000 cu. ft.
- **Low Cost, High Capacity**—On a size for size basis.



CLOSED OPEN

How It Works

CLOSED: Oil collects on top of water in trap. Air in trap floats bucket. Valve held closed by pressure.

OPEN: When water displaces air in bucket, bucket sinks, pulls on lever and opens valve. Oil floats out along with condensate.

SEND FOR BULLETIN

Bulletin No. 2024 shows how to select air traps for any job. Also gives complete data on all Armstrong air traps. For a copy, call your local Armstrong Representative, or write:

ARMSTRONG MACHINE WORKS

8852 Maple St., Three Rivers, Michigan Satisfaction Guaranteed 803-AT

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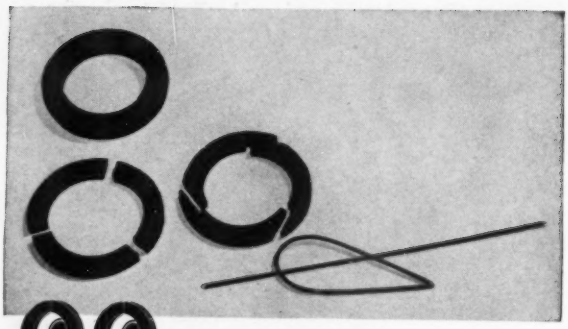

Look to COOK for Better PACKING RINGS!

Whatever your packing-ring requirements, you can depend on Cook for a ring *design* and ring *material* that will deliver maximum efficiency at minimum cost.

One *source*, one high standard of *quality* — that's what you get when you specify Cook — packing-ring pioneers since 1888. Write direct for complete technical data. C. Lee Cook Company, 930 So. 8th St., Louisville 8, Ky.

MATERIALS

GRAPHITIC IRON
(Exclusive with Cook)

COOKMET
(No. 1—Plastic Bronze)
(No. 2—Semi-Plastic Bronze)
(No. 3—Alloy Bronze)

BABBITT
(Highly Anti-Frictional)

COOKROC
(Laminated Bakelite: Standard, Hi-Temp and Graphitized)

CARBON
(For Non-Lubricated Service)

C. LEE COOK COMPANY
Sealing Pressures Since 1888

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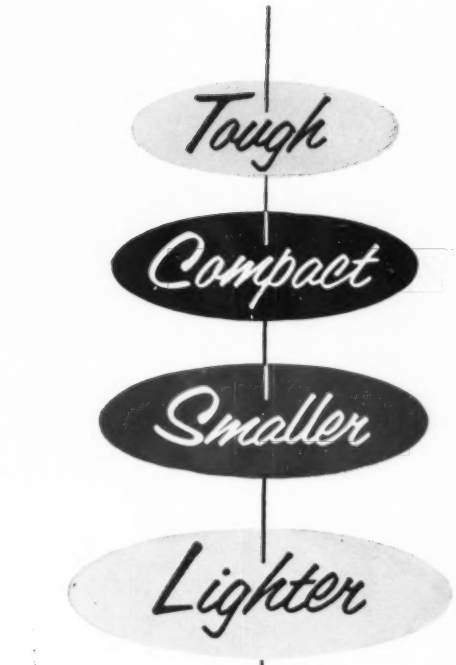


EVERYTHING YOU WANT
IN A QUICK-CONNECTIVE PNEUMATIC COUPLING

Hansen Series RL One-Way Shut-Off Couplings will handle any job in your shop using ¾" to ⅛" connections—from the air line to the air tool. All Hansen Series 2-RL Sockets and Plugs are interchangeable with each other. Likewise all Sockets and Plugs of the slightly larger, greater capacity Series 3-RL are similarly interchangeable with each other.

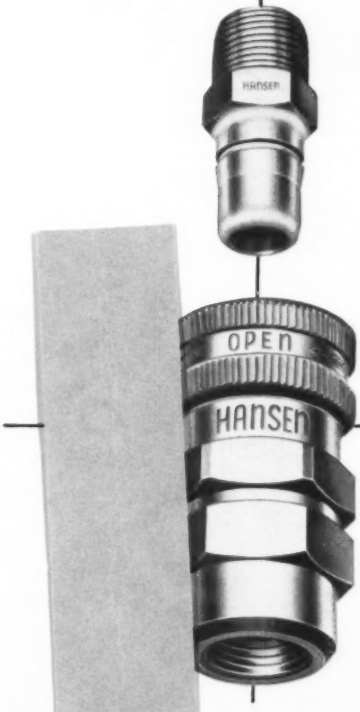
Consequently, by standardizing on either Hansen Series 2-RL or Series 3-RL Couplings, you eliminate any need for various size couplings in your hook-up—make it easy to keep stock of parts in balance—and hold inventories to a minimum.

Machined from solid steel bar stock, Plugs and Sockets are hardened and rust-proofed for long wear.

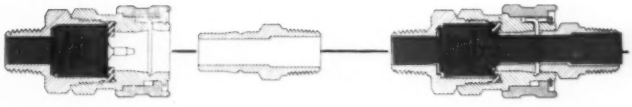
Locking ring provides positive lock and assures tight fit. Equipped with automatic sleeve lock.

THE HANSEN SERIES RL

QUICK-CONNECTIVE RING-LOCK COUPLING



Relative size of ordinary coupling required for effective handling of same volume



Blue section shows how Socket, when disconnected, automatically shuts off air by leak-proof seal of metal valve against rubber valve seat.

Connected Hansen Ring-Lock Coupling. Blue section shows free flow of air through connected Coupling.

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Here's an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings—including Special Service Couplings for L.P. Gas, Steam, Oxygen, Acetylene, etc.

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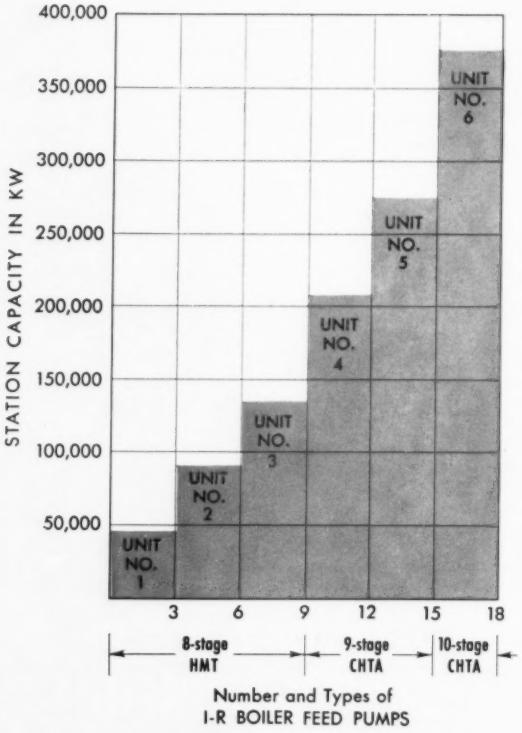
3 MORE I-R BOILER-FEED PUMPS

serve Unit No. 6 at

H. T. Pritchard Generating Station



THIS latest installation at Indianapolis Power & Light Company's H. T. Pritchard Station brings total plant capacity to 376,000 kw—served by a total of *eighteen* Ingersoll-Rand high-pressure boiler-feed pumps.

Unit No. 6 is served by the three 10-stage Class CHTA boiler-feed pumps shown above, each direct driven by a 1250 hp motor and rated 875 gpm with 4451 ft. total head. These pumps feature Ingersoll-Rand's proven double-case construction and "Unit-Type" rotor assembly. And like all I-R boiler-feed pumps at the H. T. Pritchard Station, they are designed to provide top performance and economy under the most severe operating conditions.

This is another case where I-R boiler-feed pumps have *sold themselves* over and over again, on the basis of past performance in the same power plant. For the best solution to your boiler-feed pump problems, just call your nearest I-R representative.

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